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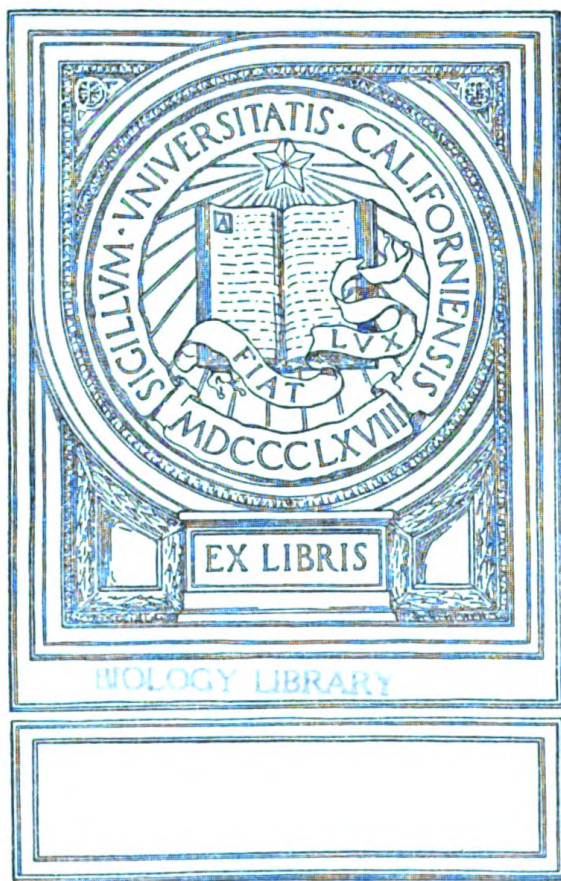
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THE MISSION OF THE MEDICAL CORPS OF THE NAVY

**TO KEEP AS MANY MEN AT AS MANY GUNS
AS MANY DAYS AS POSSIBLE**

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JANUARY 1943

No. 1

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THE MEDICAL DEPARTMENT OF THE NAVY



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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of professional interest.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T McINTIRE,
Surgeon General, United States Navy.

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NOTICE TO CONTRIBUTORS

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

In submitting articles for publication either in the *BULLETIN* or in other journal, the author should include a signed statement to the effect that "the opinions or assertions contained therein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large." (Art. 113 (2) U. S. Navy Regulations.) If forwarded for publication in other journal the article must be submitted in duplicate, one copy being retained in the Navy Department files.

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The editor regrets to have to say that reprints of articles can no longer be supplied by the Government Printing Office.

ROBERT C. RANDELL, *Editor*,
Lieutenant Commander, Medical Corps,
United States Naval Reserve.

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U. S. NAVAL MEDICAL BULLETIN

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SPECIAL ARTICLES

FOREWORD TO SYMPOSIUM ON IMMERSION BLAST INJURIES¹

By J. J. A. McMULLIN, Captain, Medical Corps, United States Navy

The mechanism and biophysics of immersion blast injuries, whatever the details may be, result principally in damage to the lungs and to the walls of certain loops of intestine. This damage may be slight or severe depending upon the intensity and proximity of the blast waves. The rupture of intestinal vessels produces ecchymosis and hematoma in the wall of affected loops and produces ileus. As in the most serious cases (17 percent of this series) the increase in intra-intestinal pressure may cause the intestine subsequently to perforate at its weakest spot or may operate against the sealing off of a primary perforation. Generalized peritonitis, abscess formation, and intestinal gangrene may follow perforation.

Conceivably the explosive force is sufficient to cause lethal pulmonary damage and to rupture the intestinal wall immediately. The type of perforation seen in our autopsies was ulcerous and did not conform to the usual appearance of primary intestinal laceration. Complete and instantaneous intestinal perforation probably was responsible for the death of those who succumbed shortly after injury. Further clinical, pathological, and experimental studies should clarify this question with certainty. An impact sufficiently forceful to rupture the intestine should be sufficient to damage the liver or spleen, and yet no injury to these solid viscera or to the stomach or kidneys was observed. However, the kidneys are shielded by their location, and most of the liver and all of the spleen are protected by the chest wall. Hemorrhagic areas were consistently found in the lungs particularly in the lower lobes, but none of the casualties seen several days after injury could be ascribed to pulmonary damage.

¹ Received for publication August 5, 1942.

The theory that these injuries are caused by water being forced up the rectum, is in my opinion, fanciful rather than factual.

It is likely that instances of cerebral damage would be prominent if submersion were complete.

Irrespective of theoretical considerations regarding the mechanism of these injuries we are concerned mostly with three practical questions:

1. How can we eliminate or minimize water blast injuries?
2. How should these patients be treated?
3. What are the indications for surgery?

The answer to the first question is protection of the anterior chest and the entire abdomen by a life jacket made of kapok or some other buoyant material. Men should be instructed to swim on their backs if the abdomen is not adequately protected.

Treatment is predominately conservative in the majority of cases. Counteract shock; maintain adequate intake of fluids, colloids and electrolytes with transfusions of plasma, and glucose and saline solution; interdict all medication, water, and nourishment by mouth; give morphine for pain and restlessness; reduce intra-intestinal pressure by continuous Wangenstein suction, preferably with a Miller-Abbott tube; administer sulfa drugs intravenously; supply oxygen generously; use whole blood transfusions if the patient is anemic or shows evidence of intra-abdominal hemorrhage; attend to vitamin requirements.

In the light of our present knowledge, operation should not be advised unless there is a definite indication. Do not operate if the patient is seen several days after perforation and is in the valley of the shadow of death from general peritonitis. Recent perforation, gangrene of a segment of bowel, and abscess formation demand surgical intervention.

Dr. Pugh exhibited excellent judgment in his selection of exteriorization resection, and secondary Murphy button anastomosis in case 15. The establishment of jejunal continuity with such a short proximal segment close to the mesocolon would have been prohibitive by any means other than the use of a Murphy button. In selected cases, exteriorization resection and secondary anastomosis with the Murphy button is sound surgery. These patients are poor operative risks and the least, the simplest, and the most expeditious is the safest and best technic.

Several members of the staff of this hospital are at present engaged in an experimental study of the effects of immersion blast on animals. The results of this work will be submitted for publication at a later date.

A. IMMERSION BLAST INJURIES¹

By JOSEPH PALMA, Lieutenant Commander, Medical Corps, United States Naval Reserve, and J. J. ULDALL, Lieutenant, Medical Corps, United States Naval Reserve.

Blast injuries, the result of detonation of high explosives under water have been given the name of "immersion blast" by Surgeon Commander Rex Williams, R. N. This type of injury presents a different picture from that of atmospheric blast injury which has become known through common usage, simply as blast injury of the lungs. The critical distance from the center of the detonation of a given charge of high explosives in the air is about 20 feet, as shown by Zuckermann in his experiments with laboratory animals, but in the water this critical distance is increased to at least 80 feet, as one would expect. A blast wave is an excessively intense longitudinal sound wave and since in water sound waves travel four times as fast as in the air, it is reasonable to assume that the critical distance from the origin of the blast is four times as great in the water as on land.

Thirty-five cases of immersion blast injuries were admitted to this hospital 5 days after the occurrence of the injury. In general their histories and physical findings were similar. They had all eaten 4 hours before the action took place. The severity of their complaints depended upon the distance they were from the source of the explosion, these distances varied from 100 to 150 feet in the more severely injured. The relative position in the water at the time also modified or increased their symptoms depending upon whether they were horizontal (prone or supine), or perpendicular, facing the blast or with their backs turned. All of the men wore life jackets except two. One was swimming with his right side down and the left chest practically out of the water, at a distance of about 90 feet from the source of explosion, and upon admission his findings were mainly in the chest and abdomen on the right or submerged side.

With the blast several experienced a lack of sensation in their legs and a feeling as if these were shortened out of proportion to the rest of the body. Others thought they had been struck at the base of the spine. Many were unconscious or stunned and others had the urge to empty their bladders and rectums. Only one case had the sensation of water rushing into his rectum and penis. No one complained of testicular pain.

About 10 to 45 minutes after the explosion, the ones that were facing the blast or swimming in the prone position began to develop abdominal symptoms varying in degree from mild fleeting cramps to

¹Received for publication August 5, 1942.

severe continuous abdominal pain. Several vomited and developed diarrhea. At the same time, practically all developed a sense of thoracic compression. Many had hemoptysis lasting from 12 to 24 hours.

The group that had their backs toward the blast or who were swimming in the supine position developed similar abdominal symptoms but to a lesser degree than the other group, and their signs and symptoms were mainly in the chest. One of these patients relates an interesting story. He had been swimming toward a raft accompanied by two of his "buddies." Tired by his exertions he had turned over on his back to rest for a moment. One companion, who had reached the raft first, was climbing aboard it. The second, a few yards behind, was still swimming in the prone position. At this moment the underwater explosion occurred about 150 feet distant. His companion on the raft suffered no injury, the other was killed immediately.

The physical findings on admission varied from slight to moderate dullness over both lungs, especially at the bases, with diminished breath sounds over these areas. Later they developed râles and rhonchi. Abdominal signs were striking and varied from moderate generalized soreness and slight rigidity to marked abdominal distention and boardlike rigidity. The severe cases had limited diaphragmatic excursion with abdominal tympany, and on auscultation no peristalsis could be heard.

Of these 35 cases, 16 were ambulatory and presented little in the way of signs and symptoms, but many had roentgenographic evidence of blast injury at the bases of both lungs. One had no physical complaints but exhibited transient psychogenic changes (case 7). Four presented physical and roentgenographic findings comparable to atmospheric blast injury of the lungs (cases 8, 9, 10, and 11). All of the 4 were wearing life jackets and had their backs turned toward the explosion; 3 being 80 feet distant and the fourth about 150 feet from the center of the detonation. Their histories are similar. Thirty to 60 minutes after the injury occurred, they began to cough up bright red blood and to develop crampy pains in the abdomen. Bloody expectoration ceased after 24 hours but the abdominal pain and distention continued. On admission, there was generalized muscular tenderness with moderate abdominal muscular resistance, tenderness, and some distention. Auscultation of the abdomen revealed fairly normal peristaltic sounds. Physical signs in the chest were more marked, especially posteriorly at the bases. There was moderate dullness, rhonchi, coarse râles, and diminished breath sounds. X-ray films revealed poorly defined areas of increased density of the inferior half of one or both lung fields comparable to the lesions seen

in atmospheric pulmonary blast injury. The 2 with the more marked physical and roentgenographic chest findings had 550 and 490 red blood cells respectively in the spinal fluid with the protein at 40–50 mg. percent. Treatment was symptomatic and expectant with complete recovery of these 4 men within 2 weeks. Of the remaining 14 cases, 6 have recovered completely without operation, 4 remain under treatment 1 month after injury, and 4 have died. In this group of 14, the presenting signs were those of shock and peritonitis. Physical signs in the chest were more often absent than present but roentgenograms of the chest revealed in all but 1 case slight to moderate areas of increased density at one or both bases.

All of the six recovered cases (1, 2, 3, 4, 5, and 6) were facing the detonation or were on their stomachs at distances varying from 80 to 150 feet. Five of the six were wearing life jackets. Two were unconscious for a short period. The histories are similar—abdominal cramps and pain beginning from 30 to 60 minutes after the blast and continuing with severity and frequency during the following days. There was some coughing up of blood-tinged sputum during the first 24 hours. Distention of the abdomen began on the second and third day after injury and was present on admission. When first seen they were critically ill, in moderate shock. Four had marked distention of the abdomen with generalized rigidity, and the fifth had an exquisitely tender abdomen with generalized boardlike rigidity. The abdomen on auscultation in these cases was silent. The four with marked distention, on the x-ray film showed the gas pattern associated with paralytic ileus; one had subphrenic air, presumably due to a ruptured viscus. These men had little if any fever and the white blood count and differential were repeatedly within normal limits. The fifth, with painful and rigid abdomen, had a low-grade fever, spiking to 101° F. daily for 10 days with a moderate leukocytosis, 14,000 to 18,000, and a slight increase in the number of neutrophils (76 percent). The response of the fever and leukocytosis to sulfadiazine therapy (blood concentration of 10 to 12 mg. percent) was satisfactory but 1 month later the right upper quadrant of the abdomen remained moderately tender with associated muscular resistance. Gastro-intestinal studies of these cases 1 month after injury (by x-ray) revealed no significant changes from the expected normal except in one patient. The sixth patient in this group suffered compression injury to the abdomen and chest under circumstances similar to the other five. On admission the abdomen was distended, painful, rigid and silent. There were no physical signs in the chest but the x-ray revealed findings compatible with a blast injury of the right lung at the base. There was low-grade fever with a moderate leukocytosis for several days. Fifteen days after injury (10 days after admission) he developed a fixed tender mass in the left

side of the abdomen a little above the level of the umbilicus. This mass gradually disappeared during the following 6 days. The only remaining symptoms were occasional episodes of generalized abdominal pain associated with constipation. Treatment was symptomatic and expectant with sulfadiazine therapy during the middle third of his period of hospitalization.

Of the group of four remaining under treatment 1 month after injury (13, 14, 15, and 16) one developed a definite personality change, one a neuromuscular disturbance, and two were subjected to necessary surgical intervention for localized abdominal complications. These four cases will be presented in some detail in the accompanying monographs.

The case histories of the remaining four are as follows; postmortem results are described in a separate report:

Case 17.—This man was doubled over in the water in the act of taking off his shoes and facing the blast about 50 feet distant, when the detonation of high explosive occurred. He was blown about 15 feet into the air and subsequently swam or floated for approximately 3 hours. Shortly after the injury occurred, he began to cough up bloody sputum and have severe abdominal pain. When first seen he was critically ill, in moderately severe shock with shallow respirations, rate 22, pulse 105, temperature 103° F. and the blood pressure 106/82. There were no abnormal chest findings on physical examination. The abdomen was markedly distended and silent. One thousand cc. of oily gastric contents were aspirated from the stomach on two occasions after which he was decompressed by Wangenstein suction. Five hundred cc. of dry plasma and 1,000 cc. of 5 percent glucose and normal saline were given intravenously. X-ray film revealed a probable blast injury of the lateral basal area of the right lung, and a small area of free air beneath the right dome of the diaphragm. Morphine was given in adequate doses. Within a few hours, the temperature rose to 105° F. and he became wildly excited. There was increasing distention of the abdomen. The excitement increased during the next few hours until he became delirious. He was placed in an oxygen tent and appropriate measures of sedation were attempted but he expired 10½ hours after admission.

Case 18.—This patient was first blown off the deck of a vessel by the detonation of high explosives and shortly thereafter was in the water about 100 feet from the source of the explosion with his back toward the blast. He was wearing a life jacket. He was unconscious for a few moments after the injury and later developed cramping abdominal pains which increased in severity and frequency. On admission, he was in a state of moderate shock and the only positive physical finds were a few crackling râles at both bases, marked distention and boardlike rigidity of the abdomen. About 1,500 cc. of oily gastric contents were washed out of the stomach during the evening of admission. X-ray film of the chest revealed poorly defined areas of slightly increased density throughout the left lung which were thought to be compatible with pulmonary blast injury. The blood chemistry was as follows: Nonprotein nitrogen 31.1 mg. percent; chloride 412 mg. percent; total protein 5.4 mg. percent; CO₂ combining power 82 volume percent. Decompression with Wangenstein suction was instituted and morphine ¼ gr. every 4 hours begun. During the first 24 hours he was given a total of 500 cc. of dry plasma and 2,000 cc. of 5 percent glucose in normal saline and a total of 25 gm. of sodium

sulfadiazine in 5 percent solution intravenously. Twenty-six hours after admission he became very restless, confused, and disoriented. Shortly afterward he developed a state of peripheral shock with a rapid and thready pulse. Supportive measures were of no avail. He gradually became worse and expired 32 hours after admission.

Case 19.—This patient was about 90 feet from the explosion, swimming on his right side, and was not wearing a life jacket. Twenty minutes after the injury, he began to cough up dark-red blood and noticed moderately severe cramps in his abdomen. The sputum was blood-tinged for at least 2 days, the pain in the abdomen persisted. When first seen, he was in moderately severe shock and somewhat restless. There was dullness on percussion at the right base with diminished breath and voice sounds. The abdomen was markedly distended but the muscular rigidity and tenderness was more marked on the right, extending well around toward the right back. During the following 5 days, until a few hours before exitus, his condition remained critical but reasonably satisfactory. The abdomen remained distended, tender, and rigid but where it had been silent in the beginning, peristalsis could be heard on the third day after admission. There was also some passage of gas and several liquid bowel movements. On the fifth hospital day a definite oval mass could be made out in the right lower quadrant of the abdomen. Decompression of the abdomen was attempted with continuous Wangenstein suction. Morphine gr. $\frac{1}{4}$ every 4 hours was given daily. Five hundred cc. of dry plasma and 2,000 to 3,000 cc. of 5 percent glucose and normal saline were given daily by vein. Sufficient sodium sulfadiazine in 5 percent solution was given to maintain a blood concentration of 40 mg. percent. The daily urinary output did not fall below 1,500 cc. In addition he received two transfusions of 500 cc. of citrated whole blood. The white blood count remained within normal limits with only a slight increase in the relative and absolute number of total neutrophils. The temperature varied from 101.1° to 105° F. Daily blood chemistry determination varied from nonprotein nitrogen low of 29.8 mg. percent to a high of 41 mg. percent; chloride 404 mg. percent low and 495 mg. percent high; plasma protein 5.1 mg. percent low, 6.8 mg. percent high; CO₂ combining power 53 volumes percent low, 68.3 volumes percent high. The x-ray films revealed findings in the base of the right lung compatible with blast injury and in the right side of the abdomen indicating retroperitoneal fluid with small bubbles of gas which could not be positively located but were thought to be retroperitoneal. Five hours before death he became increasingly restless and then wildly excited. Other supportive measures were unsuccessful and he died 5½ days after entrance.

Case 20.—This man was perpendicular in the water wearing a life jacket, facing the blast and about 100 feet distant. Immediately thereafter, he began to cough up bright-red blood and to develop fleeting abdominal cramps which, however, increased in intensity and frequency. There was loss of consciousness for a short period. He also vomited on several occasions. When first seen, he was critically ill and in severe shock. The abdomen was markedly distended, there was boardlike rigidity and no peristalsis could be heard on auscultation. There was dullness over both bases of the lungs posteriorly with depression of breath sounds. This patient was wildly excited, disoriented, and delirious almost from the beginning which made all attempts at therapy very difficult. Decompression by Wangenstein suction was maintained with reasonable efficiency in spite of the fact that the patient would often disconnect himself from the appar-

atus. Morphine gr. $\frac{1}{4}$ was given every 4 hours daily. Paraldehyde was found to be the most effective hypnotic of the several given. The first 6 days after entrance, there was little change in his condition, and it was possible to give him daily at least 500 cc. of dry plasma and 2,000 to 3,000 cc. of 5 percent glucose in normal saline by vein. The white blood count and differential gradually increased from within normal limits to a high of 12,950 with total neutrophils of 86 percent. The temperature varied from 102° to 104° F. The urinary output did not fall below 1,200 cc. daily until the seventh day when he became anuric. At this time the blood pressure, which had been 110/72, dropped to 82/64. The anuria was thought to be a complication of the peritonitis and not a result of the sulfa-drug therapy. The blood concentration of the drug which had been maintained at 35 or 50 mg. percent fell to 23 mg. percent on the seventh day. After a 36-hour period of anuria and 8 days of hospitalization, the patient died. X-ray film of the chest on admission revealed some slight blast injury to the left lung at the base, and of the abdomen, some dilated full intestinal loops in the left upper quadrant. The blood chemistry findings varied between a total protein low of 5.2 mg. percent and 7 mg. percent high; chloride 484 mg. percent low, 569 mg. percent high; CO₂ combining power 55 volumes percent low, 60 volumes percent high. Nonprotein nitrogen remained within normal limits for the first 4 days rising to 51 mg. percent on the fifth day, 92 mg. percent on the sixth day and to 105 mg. percent on the seventh day.

SUMMARY

1. Immersion blast injury produced by the detonation of high explosive in the water is characterized chiefly by abdominal pathology with secondary effects in the bases of both lungs and the central nervous system.

2. There was no external evidence of injury.

3. Thirty-five cases were admitted to the hospital 5 days after the injury occurred.

a. Sixteen were ambulatory with little in the way of complaints but many had roentgenographic evidence of blast injury at the bases of both lungs.

b. One had a transient psychogenic change.

c. Four presented physical and roentgenographic findings comparable to atmospheric blast injury.

d. Of the remaining 14, who presented signs and symptoms of severe abdominal injury:

(1) Six recovered completely without operation.

(2) Two are recovering without surgical intervention.

(3) Two are recovering after necessary surgical procedures.

(4) Four died. The postmortem results are described in a separate monograph.

4. Distance from the source of the detonation of high explosive and the position of the individual in the water were obviously factors of major importance in the type and severity of injury produced. The wearing of a life jacket apparently afforded some degree of protection.

B. SURGICAL REPORT ON IMMERSION BLAST INJURIES ¹

By H. L. PUGH, Commander, Medical Corps, United States Navy

Surgical consultation was requested upon 7 of the 35 water blast injury cases recently admitted to this hospital. Recommendation was made in each instance that the patient be transferred to the surgical service and this recommendation was promptly complied with.

One of these cases (17) was dying at time of reaching the surgical ward and expired within an hour. Five days had elapsed since injury. Another (20) was manifestly moribund at time of transfer to surgery and died that night. He had survived his injury by 12 days.

X-ray had revealed free air beneath the diaphragm of the first of these patients and postmortem examination revealed multiple perforations of small bowel (lower ileum and jejunum), with a general peritonitis of apparently several days' standing. The perforations appeared to have developed at the site of local devitalized areas. Both lungs showed evidence of contusion.

Postmortem examination upon the second fatal case revealed massive hemorrhage into the peritoneal cavity, and the whole of the cecum and ascending colon was a formless, functionless, hemorrhagic mass. Lungs showed evidence of severe contusion. There was no demonstrable evidence of perforation in this patient's alimentary canal.

Transferred along with the first fatal case (17) and in common with him, showing free air beneath the diaphragm, was a patient (1) who, although regarded as critically ill, responded well to symptomatic treatment and left the hospital for the mainland by reason of survey 2 weeks after admission. He was objectively and subjectively symptom-free at time of leaving.

Two officers were referred to the surgical service. The first of these (case 6) developed a tender mass in the left side of the abdomen slightly above the level of the umbilicus 10 days after admission to the hospital. This disappeared following administration of an enema and although he continued to complain of sporadic pains in the abdomen, his bowel function remained regular; his temperature, pulse, and respiration were normal, and his appetite good. He was surveyed to the mainland about 3 weeks after admission.

The second officer (13) constituted an orthopedic problem by reason of fractures of body of second lumbar vertebra and transverse processes of first, second, third, and fourth lumbar vertebrae. He was surveyed to the mainland.

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This leaves only two patients upon whom actual surgery was instituted.

The first (case 15) was transferred from medicine to surgery 6 days after admission with an x-ray diagnosis of intestinal obstruction. A markedly distended loop of small bowel was shown in approximately midabdomen. The advisability of immediate surgical intervention was considered, but a definite indication for such a step did not seem to exist. A Miller-Abbott tube was introduced and patient was placed upon heavy doses of prostigmine. His obstruction cleared up fairly promptly and in fact his whole condition became so markedly improved that he was allowed out of bed within a week and seemed on the road to complete recovery. However, immediately after breakfast on July 2, 4 weeks after injury, he was seized with severe pain in his epigastrium and left hypochondrium. He vomited once and quickly lapsed into marked shock. Energetic means were employed in an effort to boost his condition to a state which would permit operative intervention without imminently precipitating a lethal exodus. Blood transfusion was given as was blood plasma and straight O₂ inhalation. The patient's response to all stimulative and supportive measures was nil. A preoperative diagnosis of mesenteric thrombosis was made and though with little hope, 4 hours after the onset of this acute episode, a high left rectus laparotomy was done under spinal anesthesia with the use of coramine to prevent fatal circulatory collapse while on the table.

Upon opening the abdomen, the omentum was found to be tightly stretched over enormously distended loops of black, gangrenous small bowel and densely adherent in the pelvis. Upon freeing the omentum and delivering it through the wound a better view of the situation could be obtained. Only after freeing a segment of the lower extremity of the jejunum from dense adhesions to the parietal peritoneum opposite the upper pole of the left kidney was it possible to deliver the gangrenous portion of gut. This was accomplished with considerable effort owing to its markedly distended and tense state. Upon delivery, it was readily recognized that this gangrenous bowel represented a volvulus involving the first 40 cm. of the jejunum, that is, from about 2 inches below the ligament of Treitz to a point a few inches proximal to where the bowel was adherent to the parietal peritoneum. In fact this adhesion undoubtedly constituted the mechanical factor which permitted such a volvulus to develop. Upon closer study it was readily apparent that the sealing off of a relatively recent perforation in the jejunum had accounted for this adhesion to the posterior parietal peritoneum.

The gangrenous segment along with its mesentery down to the root was resected and a catheter was secured by purse-string into the

distal end of the proximal segment and the proximal end of the distal segment. The upper or proximal segment was so short as to be secured with difficulty to the parietal peritoneum of the anterior abdominal wall. The proximal end of the distal segment was brought completely through the wall and was secured to the structures through which it passed.

Almost immediately upon placing clamp on the mesentery of this viciously pathological loop of bowel and thereby prohibiting further absorption into the systemic circulation, an improvement in the patient's general condition was definitely perceptible. Although remaining in a critical state for several days, he continued to improve steadily under repeated blood transfusions and maintenance of fluid and electrolyte balance by unremitting intravenous therapy, the introduction of bile, pancreatic, and gastric juice into catheter communicating with lower segment of small bowel and the employment of a special feeding mixture, rich in nutriment and vitamins, which was likewise introduced into the lower catheter along with the drainage from the upper catheter. One week following the resection patient's abdomen was again opened under spinal anesthesia and after effecting as careful toilet of the operative area as possible, the two bowel segments were reunited by means of a Murphy button. One week has now elapsed since this latter operation and the patient's convalescence to date has been highly satisfactory. Healing of the abdominal wound by first intention has failed. The layers have separated down to the peritoneum; however there is no evidence of leakage at the site of the intestinal anastomosis and the patient is handling a liberal diet without difficulty. Ultimate complete recovery is expected.

The last of these blast injury patients (16) was transferred to the surgical service 11 days after his admission to the hospital. He presented a tender mass in the right upper abdominal quadrant in the region of the gallbladder. This mass was believed to represent an abscess. Fluctuation was readily demonstrable. Under local anesthesia, this mass was opened through a high right rectus incision on the day of his transfer. About 500 cc. of foul-smelling fluid containing pus, tissue detritus, and what appeared to be liquid and semisolid fecal matter were aspirated. During this aspiration a piece of necrotic tissue was sucked into the wound, was grasped by means of a hemostat and upon light pulling was delivered in its entirety. It constituted what appeared to be the whole of the greater omentum. This was later confirmed by laboratory examination. The odor of this gangrenous slough surpassed in vileness anything this writer has ever experienced. The wound was closed lightly about several ample drains communicating with the abscess cavity and within a few days

a fecal fistula of the first magnitude had become established. The character of the fecal discharge from this opening was typical of large bowel (cecal or ascending colon) contents.

About a week following the establishment of this fecal fistula, a mass of tissue simulating the end of a gangrenous segment of gut presented in the wound. Upon slight traction it carried away and was delivered in its entirety. Laboratory examination revealed findings leading to the belief that this gangrenous tissue was a segment of small bowel measuring 8 by 3 by 2 cm. Subsequent x-ray examination following the ingestion of barium, however, revealed no evidence of interruption of continuity of the small bowel. On the contrary it revealed the ingested barium as well as that introduced by enema, to be escaping from the alimentary canal through a fistula communicating with the large bowel at the hepatic flexure. Whether or not the sloughed portions of viscus represented a segment of large bowel, is as yet a moot question. In any event, the fecal fistula is becoming smaller and at least 50 percent of the fecal current bypasses it, enters the transverse colon and is ultimately evacuated through the rectum. The patient is gaining in weight and aside from occasional complaint of abdominal cramps seems well on the road to recovery. In any event, it is contemplated that some sort of surgical intervention will be necessary in order to close completely the fecal fistula. This will be undertaken in the near future.

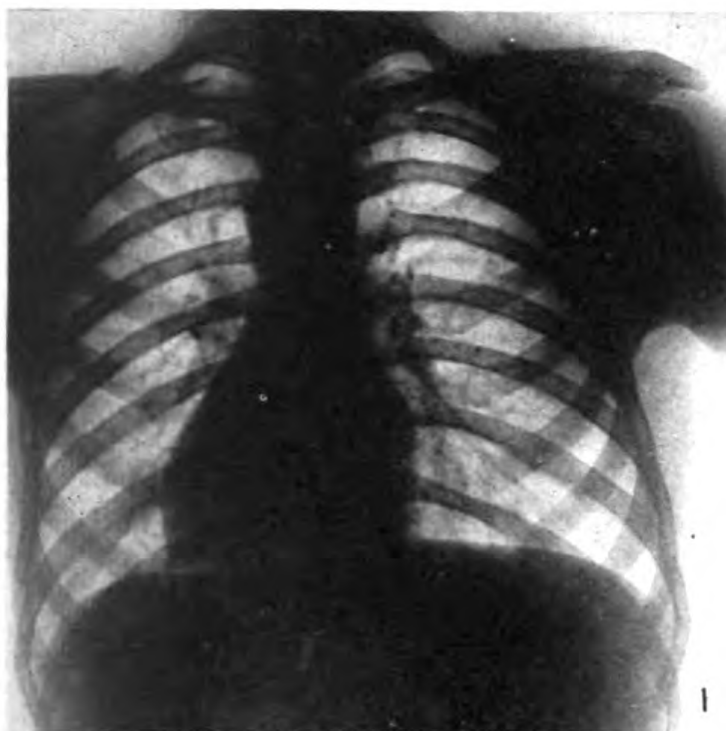
C. ROENTGEN FINDINGS IN IMMERSION BLAST INJURIES ¹

By RUSSELL GATES, Lieutenant Commander, Medical Corps, United States Naval Reserve

The purpose of this report is to record the roentgen findings in a series of 35 patients who had been subjected to severe immersion blast. The survey is only a sample of the total number of cases inasmuch as many were killed by the blast and others died from their injuries before reaching this hospital. Most of the critically and seriously injured patients who reached this hospital 5 days after the engagement are included in this survey.

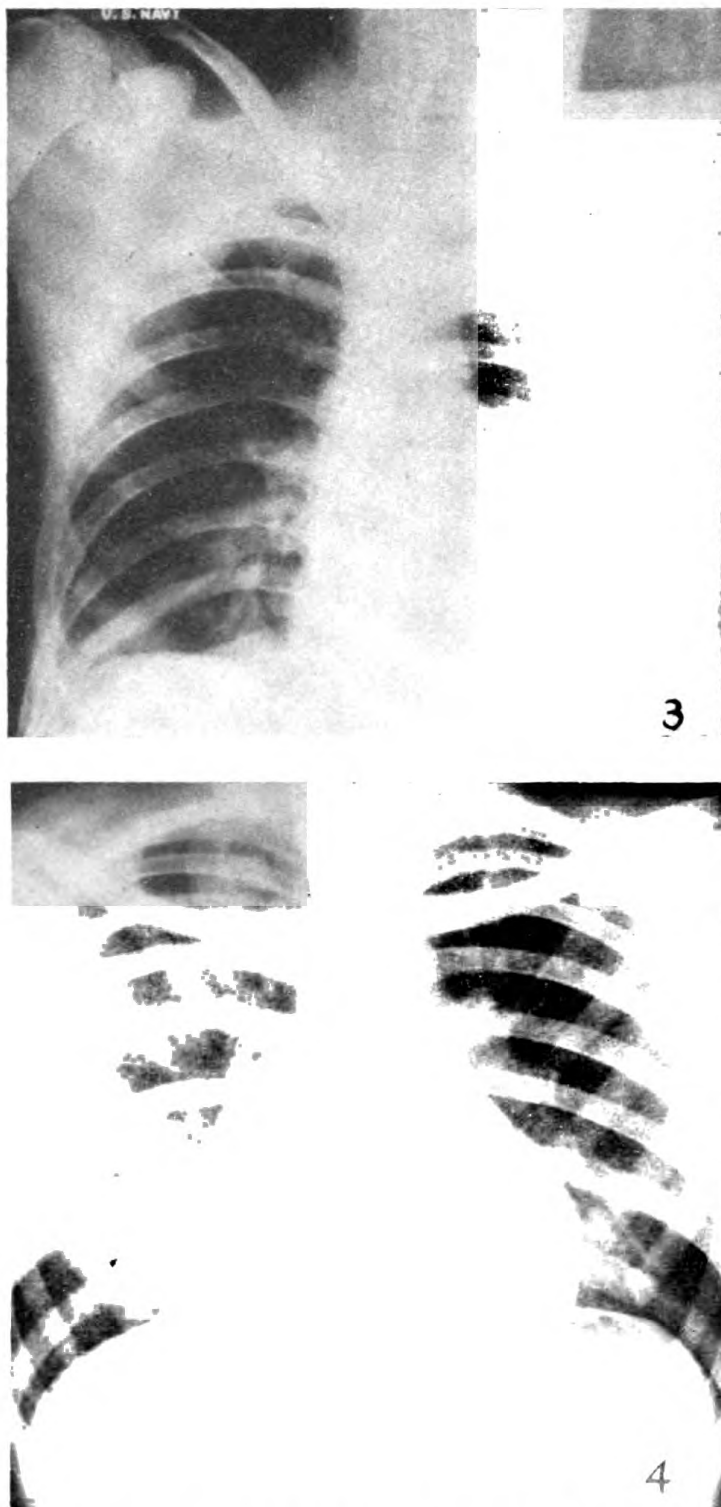
Of the 35 cases whose chests were studied by x-ray examination only 5, about 14 percent, were considered entirely clear. The remaining 30 showed areas of increased density in one or both lungs which were confined largely to the lower lobes, especially to the costophrenic angle and just above the diaphragm. The most common finding, frequently bilateral, was a fuzzy linear zone of increased density situated just above the diaphragm laterally and in the costophrenic

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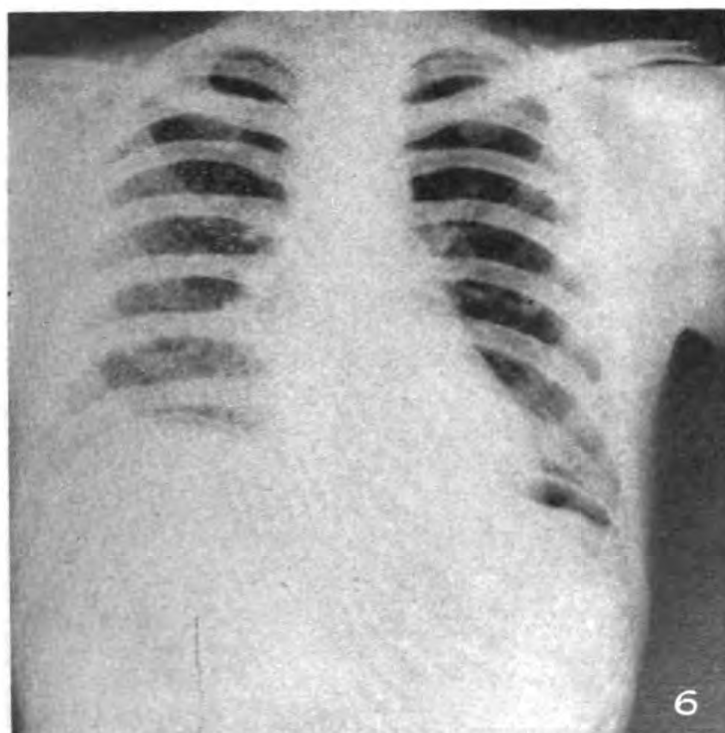
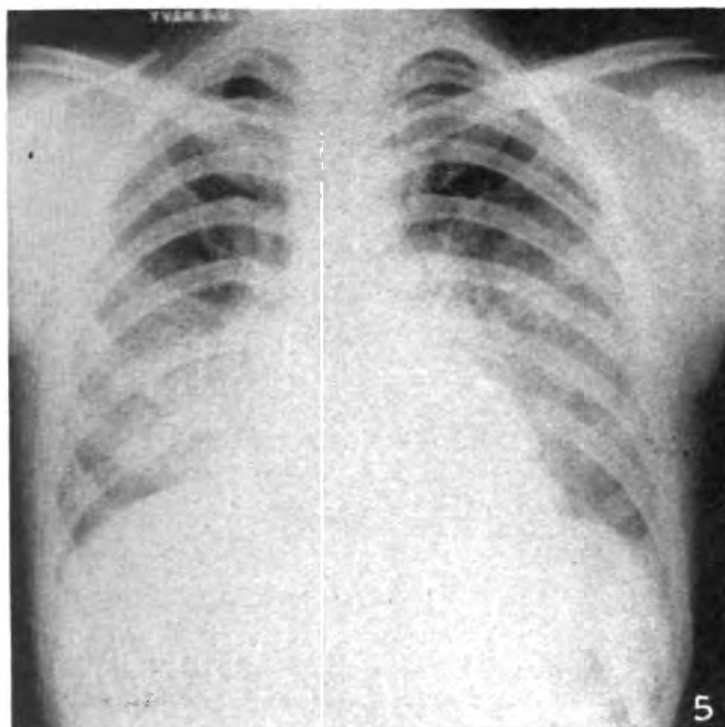


1. NOTE THE FUZZY LINEAR ZONE OF INCREASED DENSITY CLOSELY PARALLELING THE COURSE OF THE POSTERIOR PORTION OF THE LEFT NINTH RIB. (HEART TRANSPOSED).—2. BILATERAL BASAL CHANGES. NOTE THE FUZZY LINEAR ZONES OF INCREASED DENSITY CLOSELY PARALLELING THE POSTERIOR COURSES OF THE TENTH RIBS. THE UPPER LUNG FIELDS ARE CLEAR.

PLATE 2

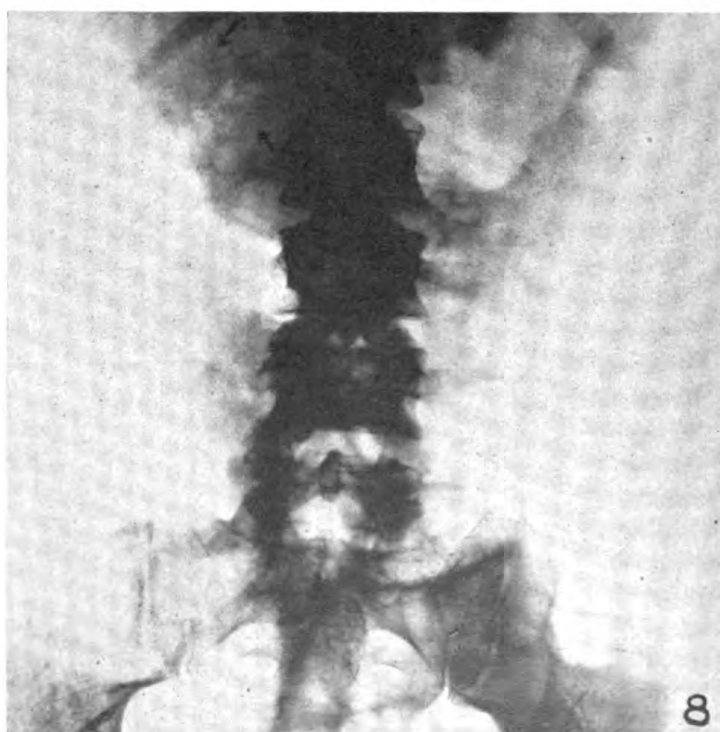
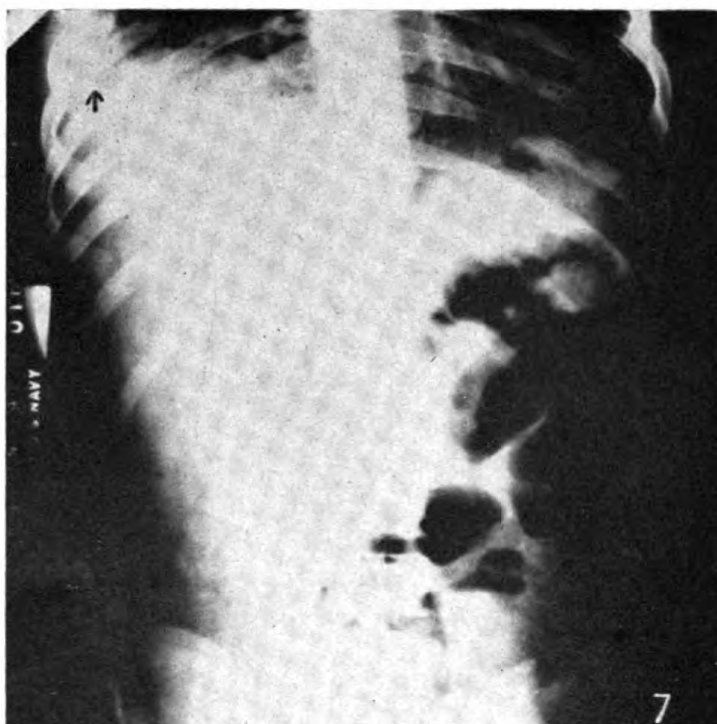


3. ILLUSTRATING A WEDGE-SHAPED AREA OF INCREASED DENSITY IN THE COSTOPHRENIC ANGLE AND ADJACENT AREA ON THE RIGHT. (THE LEFT CHEST WAS CUT OFF BECAUSE OF A TECHNICAL ERROR.)—4. NOTE THE FAINT HOMOGENEOUS DENSITY OVER THE GREATER PORTION OF THE RIGHT LUNG. ONLY THE PERIPHERY OF THE BASE AND APEX ARE CLEAR. THE LEFT LUNG IS CLEAR.



- 5 NOTE THE LARGE AREAS OF INCREASED DENSITY IN THE LOWER HALF OF EACH LUNG FIELD, MORE MARKED ON THE LEFT. THE LUNGS WERE ALMOST CLEAR SIX DAYS LATER.—6. NOTE THE FREE GAS UNDER THE DIAPHRAGM ON EACH SIDE. VERY FAINT AREA OF INCREASED DENSITY LEFT BASE. THIS PATIENT MADE AN UNEVENTFUL RECOVERY WITHOUT SURGERY.

PLATE 4



7. (CASE 19). NOTE THE ABNORMAL DENSITY OF THE RIGHT SIDE OF THE ABDOMEN WHICH OBSCURED THE RIGHT KIDNEY AND PSOAS MUSCLE. LOOPS OF SMALL INTESTINE, MODERATELY DISTENDED WITH GAS, LYING TO THE LEFT OF THE MIDLINE. PLEURAL EFFUSION RIGHT SIDE.—8. (CASE 16). NOTE THE COLLECTIONS OF SMALL GAS BUBBLES IN THE RIGHT UPPER QUADRANT OF THE ABDOMEN. A POORLY DEFINED AREA OF INCREASED DENSITY OVER THE RIGHT SIDE OF THE ABDOMEN WAS SEEN IN THE ORIGINAL FILMS. BARIUM MEAL STUDIES AFTER SURGICAL DRAINAGE OF AN ABSCESS IN THE RIGHT UPPER QUADRANT SHOWED FISTULOUS TRACTS FROM THE HEPATIC FLEXURE OF THE COLON TO THE ABDOMINAL INCISION. THE BUBBLES OF GAS SHOWN ABOVE WERE EVIDENTLY IN THE FISTULOUS TRACTS.

angle. The linear course of the densities was in most cases parallel to the course of the posterolateral portions of the lower ribs (figs. 1 and 2). The margins of the abnormal zones of density were poorly defined particularly at their proximal and distal ends. The size of the linear densities varied from about 3 by $\frac{1}{2}$ cm. to about 5 by 1 cm. Several cases showed wedge-shaped areas of increased density occupying the lower lateral portion of the lung field, that is, the costophrenic angle and adjacent area (fig. 3). The apex of the wedge was proximal and medial and the wedges measured about 6 cm. in maximum dimension. A few cases showed large poorly defined zones of faint homogeneous density in the lower lobe or lobes while others showed large and small nodular areas of increased density. One case showed a faint diffuse density of the greater portion of the right lung, only the periphery of the apex and base being clear (fig. 4). About 30 percent of the cases showed associated pleural changes, a thin line of pleural thickening or film of fluid in the costophrenic angle. Follow-up studies showed an increase of pleural fluid in only a few cases.

In general, the abnormal zones of density noted in the lungs were fainter and less sharply defined than the shadows seen in cases of bronchopneumonia or atelectasis. The cases showing more or less generalized changes in the lungs were closely similar to the reported cases of "air blast" of the lungs. The fact that most of the patients in this group were wearing life jackets at the time of the blast may account for the distribution of the abnormal changes to the basal regions of the lungs. It is not within the scope of this report to discuss the causes of the abnormalities noted.

Complications of the chest injuries were few. There were several who probably had some degree of pulmonary edema. One case had an associated slight atelectasis without mediastinal displacement. One developed extensive bilateral changes interpreted as being bronchopneumonia or edema. None showed pneumothorax, subcutaneous emphysema, empyema, or lung abscess. No abnormalities were noted in the heart, the mediastinal structures, or the ribs, except in case 22, mentioned later.

It was presumed that the abnormal densities noted in the lungs were due to edema and to large and small areas of hemorrhage in the lung parenchyma. Rapid resolution of the densities was a striking feature in most cases (fig. 5). In many of the cases showing slight changes, the lungs were clear or almost clear 10 days after admission, 15 days after injury.

Symptoms referable to the abdomen were present in all the cases of this group and in those who had abdominal x-ray studies by flat plates, the following abnormal findings were observed:

1. Gaseous distention of the small intestine. Distention by gas was confined largely to the small intestine and in some cases to segments of the small intestine, but in all cases there was gas in the colon, indicating ileus rather than obstruction. Distention was marked in some cases and only moderate in others. In several of the cases, the loops of distended intestine were rather widely separated by bands of density indicating fluid or exudate between the loops. The findings were essentially the same as those seen in peritonitis.

2. Free gas in the peritoneal cavity indicating perforation of an abdominal viscus was observed in two cases. One of these cases was not in serious condition and made an uneventful recovery without surgery (fig. 6). In most of the patients where the condition was serious or critical no special studies to determine the presence or absence of free gas in the peritoneal cavity were made. From the clinical and autopsy findings of a few cases it seems likely that they would have shown such free gas.

3. Abnormal soft tissue densities were seen in several cases and these usually occupied most of one side of the abdomen. In several instances the soft tissue densities were of sufficient degree to obscure the retroperitoneal structures (fig. 7). The abnormal densities were presumed to be due to fluid, hemorrhage and/or exudate. In all except one case, the peritoneal fat line was clearly distinguished.

4. Numerous tiny bubbles of gas were seen within the abnormal areas of soft tissue density in three cases, and it seemed likely that the bubbles were not within the lumen of the intestinal tract. The exact location of the bubbles was not immediately determined, but it was suspected that they were from perforations of the intestinal tract and were dissecting in the abdominal wall or retroperitoneal structures.

5. Gastro-intestinal studies by barium meal with particular attention to the small intestine were carried out in six cases, five of which were considered recovered. One of this group, case 22, had transposition of the heart and were studied in particular to demonstrate the complete transposition of the viscera in his case. There were no abnormal findings in the gastro-intestinal tract of this patient aside from the transposition. Case 16 (fig. 8) showed the small gas bubbles in the right upper quadrant and had surgical drainage of an abscess in the right upper quadrant of the abdomen. He was studied by barium meal and barium enema to determine the origin of a fecal fistula which developed in the abdominal incision following drainage of the abscess. The fistulous tracts were found to originate at the superior margin of the hepatic flexure. One of the other four cases showed coarse mucosal markings in the upper jejunum instead of the normal fine feathery pattern and there was slight "puddling" in the jejunum and ileum as well as slight segmentation. Some of the loops of the jejunum and

ileum were slightly dilated but there was no evidence of obstruction. Two cases showed very minor and questionable changes of a similar type. Hemorrhage and edema of the walls of the intestines, localized or generalized, as a result of the trauma sustained at the time of the blast was suspected as the cause of the abnormalities seen in the barium studies. Hemorrhage and edema of the intestinal walls was found in the cases which went to autopsy.

SUMMARY

The x-ray findings in the chests of all and in the abdomens of 12 of 35 patients who had been subjected to immersion blast are described. Although all the patients had symptoms referable mainly to the abdomen, 30 or 86 percent showed abnormal densities in one or both lungs.

The abdominal studies revealed some degree of gaseous distention of the small intestine in all cases. There was evidence of perforation of the intestinal tract in four cases, two showing free gas in the peritoneal cavity and two showing small bubbles of gas apparently in tissues outside the intestinal tract.

Rather large, soft tissue densities, presumably due to accumulations of fluid, were seen in four cases.

Gastro-intestinal studies by barium meal in five recovered cases showed a definite abnormality in the mucosal pattern and walls of the small intestine in one case. A fecal fistula originating at the hepatic flexure was seen in one case.

D. THE PATHOLOGY OF IMMERSION BLAST INJURIES ¹

By A. M. ECKLUND, Lieutenant Commander, Medical Corps, United States Naval Reserve

On June 9, 1942, a series of submersion blast injury cases were admitted to this hospital. En route from the battle area 26 additional had died and had been buried at sea. It is known that the cases which reached the hospital had been swimming or floating in the water when a detonation took place beneath the surface. The actual circumstances prevailing at the time varied in each instance and this variation must be taken into consideration in evaluating the subsequent course of each case.

The lesions produced by *atmospheric* blast have been described repeatedly; studies being reported both on human beings injured by bomb detonations and on experimental animals where conditions were

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controllable as to force, distance, protection, etc. (1) (2) (3) (4) (5) (6) (7). These references all stress several points with respect to humans exposed to blast:

1. Absence of external signs of trauma or injury.
2. Extensive effusion of blood and fluid into the pleural spaces.
3. Hemorrhage into pulmonary tissues.

Of the *immersion* blast cases at this hospital, four came to autopsy and two to surgery, and it is the purpose of this paper to review and summarize the postmortem findings and the pathological reports on the operative specimens. As before mentioned, the literature contains abundant references to atmospheric blast injury but comparatively little can be found concerning injury in the water where the principals of hydraulics prevail. Breden, d'Abreu and King (8) review the literature and add histories of cases subject to detonation while in the water. To quote from their summary:

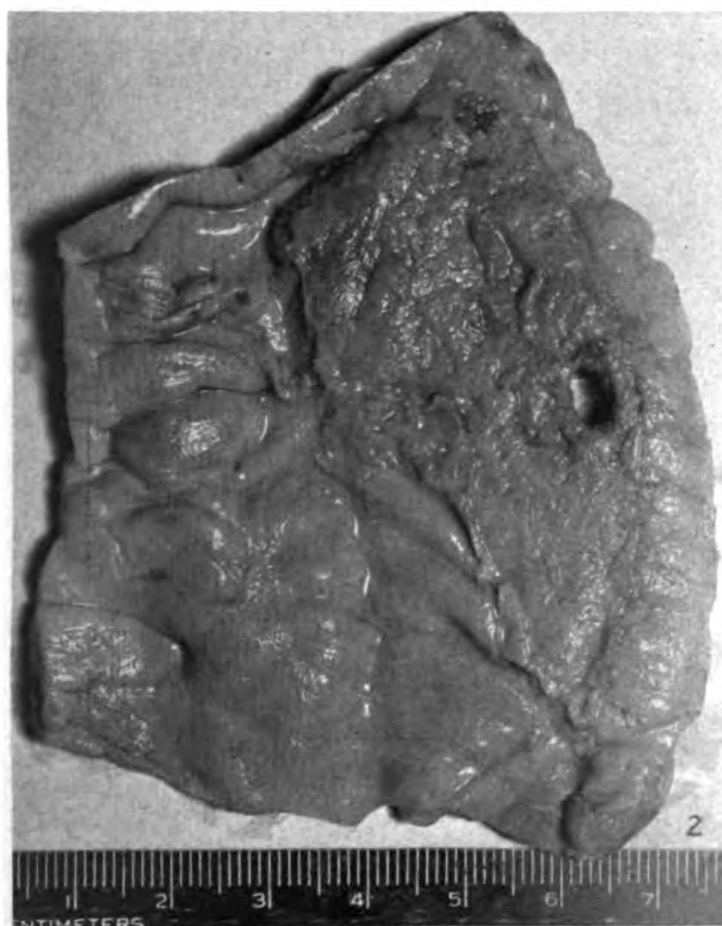
Sudden compression waves produced by torpedo and depth charge explosions in 10 patients showed their chief effects in the abdomen and caused subperitoneal and submucous hemorrhages and lacerations of the intestines * * * Seven patients recovered completely, 2 recovered after surgical drainage of pelvic abscesses; and 1 died after operation for a tear in the small intestine.

The postmortem on the fatal case is described in detail. In this case, together with other pathology, a perforation was found about three feet from the ileocecal valve.

In atmospheric blast the principal seat of trauma is in the thoracic cavity, while in the four cases coming to autopsy here, although there were pulmonary lesions, the predominating and urgent pathology was abdominal.

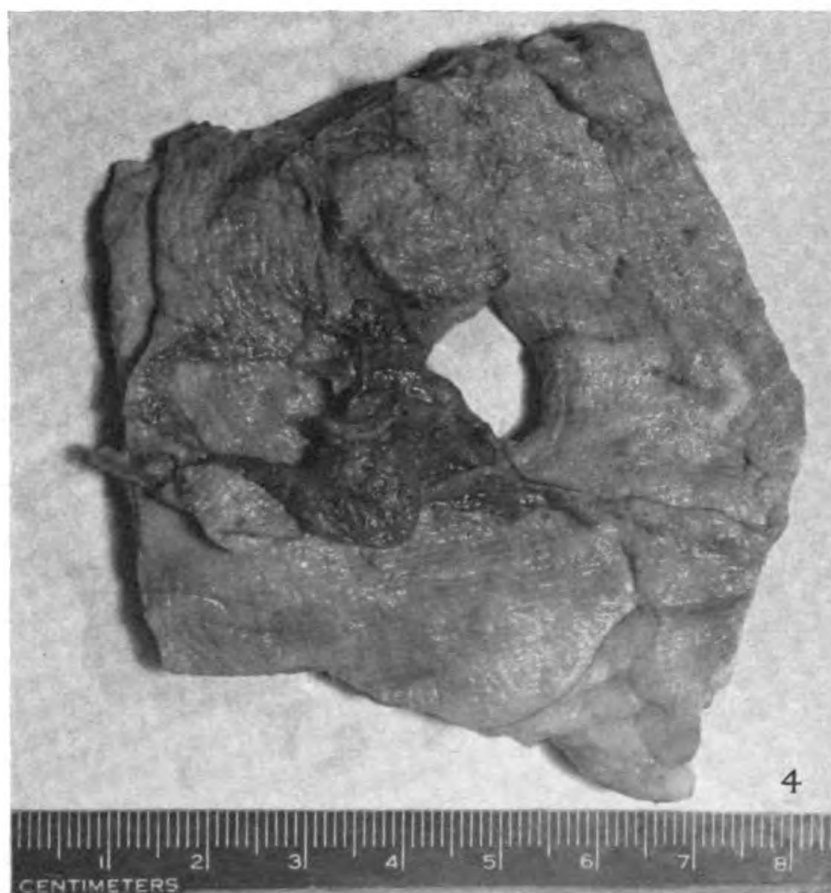
CASE REPORTS

Case 17.—A white male, age 19 years, fireman, second class, died June 10, 1942, at 12:34 a. m., and was autopsied at 1:30 p. m., 6 days after injury. There were no external evidences of trauma or injury to the body. The abdomen was distended and on opening contained about 600 cc. of purulent fluid. A generalized fibrino-purulent peritonitis was noted, the peritoneal surfaces and omentum being dull, brownish red in color, with many strings and tags of purulent exudate adhering to the various organs. The small intestine was tremendously dilated, but practically empty, up to the ileocecal region, where it had collapsed. Two perforations, each measuring 1.2 cm. in greater diameter, were present in this area adjacent to the mesenteric border, 15 cm. back from the ileocecal valve. These perforations, which were oval in shape and with a blown-out appearance, were situated in linear tears through the mucosa and submucosa, in the bases of encircling folds (figs. 1 and 2). The tears, which were longer than the actual perforations, lay in the circumference of the bowel, in a line drawn at right angles to the longitudinal axis. The edges of the perforations were necrotic, but the adjacent gut wall was in comparatively good condition. The lower right abdominal quadrant and the pelvis contained large amounts of purulent material and brown fluid having a fecal odor.



1 AND 2. (CASE 17). TWO PERFORATIONS NEAR MESENTERIC BORDER, 15 CM. FROM ILEOCECAL VALVE.

PLATE 6



(CASE 18). PERFORATION IN DUODENUM, 8 CM. FROM PYLORUS.—4. (CASE 20)
ONE OF THREE PERFORATIONS IN POSTERIOR WALL OF CECUM.

In the chest 200 to 300 cc. of serosanguineous fluid was present in each pleural cavity. Gross sections through the lungs showed numerous discrete extravasations of blood into the lung parenchyma, producing a mottled appearance against an extremely hyperemic background. In the anterior portion of the middle lobe of the right lung, a massive hemorrhagic area was present, distinctly demarcated, with a liverlike consistency.

The brain and the skeletal systems were free from gross abnormalities.

Case 18.—White male, age 22 years, seaman, second class, died June 11, 1942, at 2:37 a. m., autopsied the same day at 10 a. m., 7 days after injury. No external signs of injury or trauma were found. The abdomen was distended, tight and tympanic, and on being opened a large amount of foul, brown, purulent fluid gushed forth. A diffuse generalized fibrino-purulent peritonitis was present, the intestines being tremendously dilated, the loops bound together by plastic exudate. The serous surfaces were dull, brownish red in color, the omentum hyperemic, brown and covered with purulent tags. The peritoneal cavity was filled with purulent fluid which drained into and filled the pelvis with thick greyish green pus. A large perforation was noted in the duodenum, 8 cm. from the pylorus, the edges of which had a blown-out, necrotic appearance, with the mucosa everting to the serosa (fig. 3). A heavy plastic exudate had formed around the orifice. A second perforation was found in the terminal ileum, 10 cm. back from the ileocecal valve. This perforation was an oval-shaped opening measuring 0.8 cm. in greater diameter, lying in the base of a linear tear in a fold of the mucosa, the greater diameter of the perforation lying at right angles to the longitudinal axis of the bowel.

In the thoracic cavity, the pleural spaces were filled with serosanguineous fluid, approximately 250 cc. being present in each side. The lungs, on gross cross section, showed innumerable dark hemorrhagic areas, patchy in character, distributed throughout all lobes. The lower lobe of the left lung was more traumatized than the other portions.

The skeletal and vascular systems and the brain were free from gross changes.

Case 19.—White male, age 17, seaman, second class, died June 16, 1942, at 2:55 a. m., autopsied the same day at 3 p. m., 12 days after injury. No external evidences of injury could be found on the body. On opening the abdomen, which was very distended and rigid, the peritoneal cavity was found to be filled with fluid blood—2,500 cc. being recovered. The peritoneal surfaces of the anterior abdominal wall were purplish black from extravasation of blood into the tissues, the contusions extending posteriorly on both sides to the perirenal structures. The serosal surfaces of the terminal ileum, the cecum, and the ascending colon were purplish black from massive hemorrhages, coming from innumerable small torn vessels rather than a single source. No perforations or evidences of peritonitis were found.

In the chest, approximately 1,800 cc. of serosanguineous fluid was present in each pleural cavity. An extreme degree of pulmonary edema was found, with numerous black, patchy hemorrhagic areas showing a liver-like consistency throughout both lungs. The bronchial surfaces were injected and hyperemic and the tubes were filled with serous frothy fluid.

The vascular and skeletal systems and the brain were free from gross lesions.

Case 20.—White male, age 22 years, seaman, second class, died June 17, 1942, at 4:20 p. m., 13 days after injury. Autopsied June 18, 1942, at 8:30 a. m. No external evidences of trauma or injury were found. The abdomen was distended, tight and tympanic and on opening showed evidences of a generalized, diffuse, exudative peritonitis. The peritoneal surfaces of the anterior abdominal wall showed massive extravasations of blood into the subserous tissues. The

intestines were dilated with gas, the loops being plastered together with purulent exudate. The serous surfaces were brownish red in color, dull and devitalized in appearance. Segments of the gut appeared black and devitalized. The omentum, which was of a dull black and brownish red color had plastered itself over the ileocecal region in an unsuccessful attempt to wall off and localize the spreading peritonitis. On raising the omentum the entire area was found to be bathed in greyish brown, foul, purulent fluid. On the posterior wall of the cecum three perforations were found, two lying in the same encircling fold of the mucosa on a level with the ileocecal valve, and the third (fig. 4) in a fold 5 cm. above, the three perforations forming the points of an equilateral triangle. The perforations were oval shaped openings, with necrotic edges, the greater diameters lying in transverse positions in the bowel, and led into a massive retrocecal abscess filled with foul greyish green pus. This abscess drained into and filled the pelvis with purulent fluid, having a fecal odor. The kidneys were enlarged, dull red and hyperemic in character. On gross cross sections the pelves and ureters were found to be packed with a brown mudlike substance identified as acetylsulfapyridine crystals and cellular debris. The bladder contained no urine but deposits of this same mud were noted.

In the thoracic cavity 900 cc. of serosanguineous fluid was present in each pleural cavity. The lungs were extremely edematous but no distinct areas of hemorrhage could be found. The bronchi were filled with frothy serous fluid.

In the skull, a subdural hematoma was found in the left temporal region, the area covered by the hemorrhage measuring 8 by 4 by 0.6 cm.

Two cases went to surgery, and it is thought pertinent to include descriptions of the surgical specimens which were submitted to the laboratory in each instance. (For the clinical courses of these two patients we refer to the surgical paper in this series.)

Case 16.—Gunner's mate, third class. On June 21, 1942, 17 days after injury, two segments of foul, necrotic tissue were received from the operating room, one piece measuring 14 by 3 by 1 cm., the other, 6 by 4 by 1 cm. These specimens, which were incredibly foul-smelling and disintegrated beyond gross recognition, were sectioned—the slides showing necrotic debris, masses of bacteria, and a few nests of fat cells. A classification of "necrotic material, probably from omentum" was all that could be made.

On July 1, 1942, 28 days after injury, a second specimen was received from the same patient. This specimen was identified grossly and microscopically as a segment of necrotic bowel, 8 cm. in length, from the upper jejunum.

Case 15.—Seaman, second class. On July 7, 1942, 33 days after injury, a specimen was sent to the laboratory from this patient—a summary of the pathological report being as follows: The specimen is a portion of the small bowel measuring 44 cm. in length, 30 cm. being twisted, dark red, and infarcted, 13 cm. in circumference, necrotic and covered with fibrin. The distal 14 cm. of the specimen is pale, edematous and thickened. Four centimeters from the infarcted area, on the surface opposite the mesenteric attachment, there is an oval perforation in the bowel wall, closed by eversion of the thickened mucosa folds. The inside diameter of the perforation is 1.3 cm. The edges do not appear to be necrotic. The greatest diameter of the opening is parallel to the villi. Microscopic examination of sections from the perforation edge shows interruption of the continuity of the bowel with eversion of the mucosa. The outer edge shows evidences of repair, in that granulation tissue, young fibroblasts and vascular extension are apparent. In and about the areas of regenera-

tion the blood vessels are dilated, with margination and diapedesis of polymorphs. The adjacent tissues show edema and evidences of acute inflammation.

Sections from the viable bowel close to the necrotic area show marked hyperemia and edema. Many new blood vessels appear over the serosal surface and between the muscle fibers.

Pathological diagnosis: Submersion blast injury with perforation of jejunum. Peritonitis, localized subsiding. Phlegmon, acute, localized, subsiding. Volvulus, jejunum, with gangrene, occurring proximal to site of jejunal perforation.

Microscopic examination of sections cut through perforations from the various autopsy cases showed that the mucosa, submucosa, muscularis, and serosa had been fragmented and perforated, apparently by forces acting from within the lumen. The opposing edges were heavily infiltrated with leukocytes, lymphocytes and plasma cells, with considerable superficial necrosis. The adjacent serosa had heavy deposits of exudate. Comparatively little regenerative cell growth, fibroblastic activity, capillary extension or evidences of repair were to be noted around the perforations. The smooth muscle fragmentation was striking.

Sections from the lungs, in various instances and areas were quite uniform, showing extensive hemorrhage into the alveoli with subsequent lysis of the erythrocytes and liberation of iron pigment. Histocytes had begun to remove this pigment. Numerous cells, resembling "heart failure cells" were present in most instances. Rupturing of the alveolar walls was a prominent feature in most sections. In other areas the entire architecture of the normal lung had been destroyed by massive hemorrhage.

In these autopsies several striking findings were noted, namely, the severe intra-abdominal trauma in each instance without external evidences of injury; the tendency for the ileocecal region to sustain the severest damage; the "blown out" character of the perforations; the extent of the peritonitis and the attempts at walling off exhibited in those cases having this reaction.

The pulmonary findings, too, were outstanding, although in evaluating these pictures we must not lose sight of the lapse of time between the catastrophe and death in each instance, with possibility of change, and also that the so called "lesions" described as "blast lung" may here be complicated or altered by inhalation of salt water and/or oil, superimposing inhalation pneumonias on lungs already traumatized by the detonation. The absence of rupture of the liver, spleen, kidneys or bladder in each instance is remarkable, as was the fact that in no autopsy was mesenteric thrombosis with subsequent devitalization of gut segment demonstrated.

Many factors enter into each individual case, a few of which are the amount of food and gas in the intestinal tract; feces in the colon;

position in the water when subjected to the explosive force; distance from the detonation; whether the mouth was open or closed, protection offered by the life jacket and the actual position of the life jacket on the wearer. An atmospheric blast wave consists of a shell of compressed gas followed by an area of lowered pressure, radiating rapidly from the point of detonation, the pressure and speed of the wave decreasing the farther it moves away. The physics of detonation in water is essentially the same except that the pressure wave travels faster and the rate of diminishing force is not so rapid.

We have, in these individuals, humans who were subjected to this tremendous compression force followed by a secondary wave of lowered pressure with end results as described above. The actual mechanism producing the lesions cannot with certainty be described from these instances alone, we cannot state when or by what force these perforations, leading to subsequent peritonitis, were produced or just what force produced the pulmonary lesions, but we do know they were produced. It is regretted that postmortem studies could not have been made at the immediate time of the catastrophe to determine the character and extent of the lesions produced by underwater detonations.

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E. NEUROLOGICAL OBSERVATIONS ON IMMERSION BLAST INJURIES¹

By H. HAMLIN, Lieutenant, Medical Corps, United States Naval Reserve

Table 1 gives the pertinent data on the cases that were observed neurologically. The condition of these patients on admission was in general that of clouded sensorium and diminished reflex activity,

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TABLE 1

	Unconscious	Life jacket	Pulmonary changes by x-ray	Abdominal signs	Neuropsychiatric abnormalities	Days after immersion blast	Lumbar puncture			Other findings
							Pressure	Cell (R. B. C.)	Total protein	
Case 7	(?)	Yes	Negative	No	Transient disorientation; somnolence.	4	135-4-125	2,200	40	
Case 8	No	Yes	Diffuse	Yes	No	6	150-5-150	550	40	
Case 9	Yes	Yes	RLL	Yes	No	6	150-5-145	490	45	
Case 2	No	Yes	?RLL	Yes	No	12	120-5-115	0	20	
Case 5	Yes	Yes	LRL	Yes	No	12	180-8-160	8	20	
Case 3	Yes	Yes	Negative	Yes	No	12	150-5-140	2	25	
Case 4	No	Yes	Mod-ately diffuse	Yes	No	12	180-6-140	5	20	
Case 11	No	Yes	RLL - LLL	Yes	No	12	175-6-160	2	40	
Case 10	No	Yes	Mild RLL	Yes	No	12	155-5-145	2	50	
Case 14	Yes	Yes	Negative. 17 days after blast had hemoptysis.	Yes	Hypersacusis; hearing loss; involuntary movements.	18	190	4 Type unstated	30	Severe residual neuropsychiatric disorder.
Case 13	(?)	No	RLL - LLL	Yes	Personality change	No tap				Fractured transverse processes L1-4 and body L-2. Subdural hematoma; left temporal at autopsy.
Case 20	Yes	Yes	RLL - LLL	Yes		No tap				

commensurate with the severity of their visceral and pulmonary injuries, which represented the more serious effects of exposure to immersion blast. When first examined all had received morphine and adequate appraisal was not possible. The history in many cases was incomplete with respect to neurological symptoms. Headache had been noticed in most cases. Persistently abnormal findings were recorded in only two patients (cases 13 and 14) which, in the latter, proved exceptional since he was seen at least a week later than any of the others. Follow-up examinations were carried out, but only single and superficial observations were made on the five patients who died and on the two who survived surgery. Autopsy on case 20 revealed a subdural hematoma over the left temporal pole which was probably the result of a direct blow rather than the blast. Cursorry neurological examination was negative eight days after injury but no lumbar puncture was done. The necropsy material was otherwise negative; spinal cords, however, were not examined and no microscopic sections could be prepared.

Lumbar punctures were not permitted on the 5 fatal cases nor on the 2 that recovered from laparotomy because of their precarious condition. Punctures were performed on 10 of the remaining 11 that showed evidence of marked or moderate blast injury to chest and/or abdomen. In 3 instances (cases 7, 8, and 9) taps, which were done 4 to 6 days following injury, revealed subarachnoid red cells and slight elevation in total protein. The history of case 7 is obscure regarding his proximity to the detonation and his posture in the water. He denied unconsciousness but exhibited a fixed amnesia surrounding the event; also disorientation and somnolence for several days which cleared completely. His spinal fluid contained 2,200 red cells on the fourth post-concussive day. Case 9 was unconscious for a short period after the detonation but recalled the event almost as well as case 8, who was not unconscious. Red cell counts were 490 and 550, and total protein 45 and 40 mg. percent respectively on the sixth day. Spinal fluid examinations on 6 of the remaining cases were done on the twelfth day after injury. A negligible number of red cells and two examples of increased total protein were found. Two of these patients gave a history of brief unconsciousness (cases 3 and 5). The finding of subarachnoid red cells and/or increased total protein correlated in each instance with a definite roentgen diagnosis of blast lesions of the lungs. Concussion of the leptomeninges of the cord presumably occurred despite the fact that all the victims were wearing life jackets. Case 13, who had no life jacket, unfortunately was not tapped, but presented clinical evidence of severe thoracic and abdominal concussion, including fracture of the body of the second lumbar vertebra and four lumbar transverse

processes. Neurological examination was not remarkable but, according to observers and former shipmates, he showed a personality change from his characteristic jovial and extrovertive behavior to an uncooperative, taciturn state that was still evident on evacuation from the hospital.

Earlier spinal fluid examinations might have produced positive evidence of central nervous system damage in some of the negative cases. Subarachnoid red cells and increased total protein probably could have been demonstrated among the five fatal cases and the two that came to surgery if punctures had been done.

Case 14 exhibited evidence of neuropsychiatric damage, chiefly in the guise of a persistent neuromuscular disorder. His case was complicated by exposure to atmospheric explosions on two occasions that preceded the immersion blast by 48 hours and a few minutes, respectively. Although knocked unconscious by both atmospheric explosions, the immersion blast appears to have been responsible for most of his abnormalities. His memory for the whole sequence of events is poor and the history is pieced together from many interviews and from corroboration obtained from other victims.

He was on deck when torpedoes struck (second exposure to atmospheric blast) and regained consciousness in the water. Rough estimation would place him about 100 feet from the underwater detonation that followed within a few minutes. He suffered immediate severe squeezing pain in legs, testicles, abdomen, chest, and head. He was wearing a life jacket and was not rendered unconscious. Two companions nearby coughed up quantities of blood and disappeared. The patient reached a life raft and subsequently spent 3 days on the deck of a rescue ship en route to port. During this period he developed controllable contractions of muscle groups in limbs and trunk, which became superimposed on residual pain in legs, abdomen, chest, and head. Bloody sputum was noted for 1 day and stools were melanic during the next week.

Several syncopal attacks occurred and he was hospitalized 16 days after exposure to the underwater explosion. Chief complaints consisted of a variable, bursting type of headache, centering behind eyes, tinnitus, sensitivity to noise, and nightmares delineating events associated with his combat experience. The neurological findings may be summarized as follows: Bilateral loss of perception for 80 percent of high tones (perforation of right ear drum); spontaneous involuntary flexion movements of upper and lower extremities, involving postural muscle groups; elevation and forward rotation of shoulders also noted; and occasional contractions in musculature of neck and trunk. Movements are paired, hyperkinetic, and become exaggerated under observation and conscious effort at control. Free intervals

increase with rest and movements cease during sleep. Marked hyperacusis present and ordinary noises set off or increase the involuntary movements in trigger fashion. Speech is halting, with difficulty in word finding that simulates emissive aphasia. If distracted during conversation, patient has trouble returning to train of thought. Disturbance in body image in the form of agnosia for right and left. Simple tests of memory and calculation poorly performed. His personality makes a good impression and the above findings are considered to be more organic than functional by most observers, suggesting focal extrapyramidal damage as well as diffuse cortical insult. Perforation of ear drum and hearing loss probably caused by atmospheric blast. Cerebrospinal fluid pressure 190 (recorded 18 days after immersion blast). Laboratory data negative.

DISCUSSION

Knowledge concerning the effects of immersion blast on the nervous system is scant, judging from the literature on blast injury in general, which deals chiefly with the clinical picture and its pathology under atmospheric conditions. Breden, d'Abreu and King do not mention neurological findings in their report of 10 cases (January 31, 1942) except in the autopsy record of one case in which "the brain was examined and found natural." Similar remarks are found in other papers on the subject (Atkins, 1940; Wakeley, 1941).

The neurological work-up on our cases is admittedly inadequate, but shows that the nervous system is vulnerable when exposed to underwater detonation, although the thoracic and especially the abdominal organs are much more liable to injury. At present little can be said regarding the exact physical mechanism and the neuropathology of immersion blast other than theoretical considerations. Compared with atmospheric environment, the velocity of a blast force in water is approximately quadrupled. Its lethal power is well-known from the practice of dynamiting fish. The quick death of well-preserved specimens picked up near the explosion site suggests a neurogenic cause, although there undoubtedly are other factors. A submerged man in close relationship to a depth charge would probably suffer similar consequences. All the survivors within the danger zone of an underwater detonation will have had their heads above water when subjected to rapid and violent bodily compression. Manifold pain in limbs, testicles, abdomen, and chest can be interpreted as a result of this force acting on the peripheral and autonomic nerves. Autonomic paralysis is one of the most important physiological effects of the entire blast syndrome, causing interruption of the interrelated reflex activity of the vascular and pulmonary systems. The five fatal cases and several others in our series had prolonged paralytic ileus.

It is reasonable to surmise that lack of intestinal motility and diminished blood supply rendered contused areas of bowel susceptible to gas pressure, the necrotizing action of intestinal contents, and possible perforation.

The bony casement of the skull and spinal canal affords excellent protection for its fluid-cushioned contents in contrast to that provided for the viscera by the belly wall and thorax. An immersed man may be partially shielded by others nearby directly in the path of the blast motion; although the force probably bends around objects in the water just as a blast wave does in the atmosphere. The individual histories of our patients clearly indicates that their various postures in the water relative to the detonation, influenced its damaging capacity in every instance. The thick, resilient musculature of the back provides greater protection than the anterior rib cage and belly wall. The role of the life jacket is important.

Presumably a blast wave of sufficient magnitude will be transmitted to the spinal canal and thence to the cranial cavity, setting up a convection force in cephalad direction through the spinal fluid and possibly the neuro-axis itself, which may be analagous to the phenomenon of cerebral acceleration that follows a solid blow to the head. Such a mechanism could conceivably damage the delicately supported vessels of the leptomeninges, giving rise to subarachnoid hemorrhage and neurological symptoms, such as headache and back-ache. Injury to the cortex and deeper brain centers is possible. Brief unconsciousness, however, after immersion blast, which occurred in many of our patients, is probably more often caused by a rapid shift in the vascular reservoirs of the great vessels, producing transient ischemia of the brain, rather than concussion.

Confirmation of neurological notions about immersion blast must await complete histological study of the nervous system of fatal cases and similar material derived from animal experimentation. Our cases nevertheless demonstrate that the nervous system, although less vulnerable than the abdomen or chest to underwater explosion, is liable to a relative degree of injury which should always be looked for by clinical examination and lumbar puncture.

NOTE BY THE EDITOR.—On September 18, 1942, a most excellent article entitled "An Experimental Study of Under-Water Concussion," was submitted for publication by a group of investigators working at the National Naval Medical Center, Bethesda, Md. These experimenters were Capt. F. C. Greaves, (MC), USN, Lt. Comdr. R. H. Draeger, (MC), USN, Lt. Comdr. O. A. Brines, (MC), USNR, Lt. J. S. Shaver, (MC), USN, and Lt. E. L. Corey, (HC), USNR. The editor was very desirous of using this as a companion piece to the preceding symposium, but owing to understandable restrictions it was not considered feasible to release it. However their findings and recommendations have been made available to the Navy through confidential channels.

On October 16, 1942, the results of independent investigations on the same subject at the Naval Hospital, Pearl Harbor, T. H., were submitted to the Bureau by Lt. Comdr. A. M. Ecklund, (MC), USNR, Lt. M. T. Friedell, (MC), USNR, and Lt. (jg) Richard Burke, USNR. This work was equally creditable with that of Dr. Greaves' group, and the conclusions of the two were remarkably uniform. Here again it was with extreme regret that the editor found himself unable to publicize them.

PAINFUL EDEMA OF THE EXTREMITIES IN SHIPWRECKED MARINERS¹

A NEWLY RECOGNIZED SYNDROME OCCURRING AFTER PROLONGED DEHYDRATION,
MALNUTRITION, AND VITAMIN DEFICIENCY IN SOUTHERN WATERS

By JAMES C. WHITE, Lieutenant Commander, Medical Corps, United States
Naval Reserve

The survivors of ships torpedoed during the winter months in the North Atlantic who have suffered prolonged immersion of their feet in cold water develop a distinct clinical syndrome. This condition is aptly described by the name "immersion foot" and closely resembles "trench foot," which caused so much disability in soldiers exposed to the cold mud of the trenches during the winters of the last war. The immersion foot syndrome can develop in a few days from dependency and immobility of the feet with chilling, short of actual freezing of the tissues. Under these circumstances legs become discolored, swollen, and numb from the ankles down. After removal from the cold an intense inflammatory reaction develops with reactive hyperemia of the deep tissues. Injury to the skin is shown by blisters, petechial hemorrhages, and impaired circulation through the cutaneous capillary bed. Thermal injury to the peripheral nerves is evidenced by sensory changes and neuritic pain during the period of recovery. This clear-cut local syndrome which involves the lower extremities has been summarized in order to point out the fact that a superficially similar, yet fundamentally different picture can result in survivors who have been exposed for more prolonged periods in lifeboats in relatively warm air and water.

During the past year it has been my privilege to see a number of survivors of vessels torpedoed in the North Atlantic who were severely incapacitated by immersion foot. Aside from the local thermal injury these men were entirely well. More recently I have had the opportunity of examining the 15 survivors of the crews of 2 lifeboats who developed a distinctly different variety of local disability in their extremities, a condition which was accompanied by generalized symptoms and signs suggestive of a deficiency disease.

¹ Received for publication July 9, 1942.

Both vessels were torpedoed in relatively warm water (around 70°) and in southern latitudes during the month of April. The men in each were adrift for nearly 2½ weeks (16 and 17 days). Owing to the fact that their ships were torpedoed well off the usual trans-Atlantic shipping lanes and they could not hope for early rescue, their allowance of water was progressively reduced from 16 ounces to a bare 5 ounces a day. With the intense sunshine and heat by day, coupled with the hard work of bailing and handling the boats, both crews developed such severe dehydration that they were unable to swallow the concentrated solid ration of pemmican, hard tack, and chocolate. After the first few days all that the men were able to swallow was a small amount of malted milk powder dissolved in their half cup of water. Three West African negroes in the crew of lifeboat A drank salt water and died. The crew of lifeboat B all survived. The men in both boats were so crowded that they were forced to sit close together with their legs dependent and to sleep in this position. A few who took turns as steersman were able to stretch their legs out horizontally during their watches; others realized that circulation in their feet and swelling were improved by flexing and extending their feet and toes. After a week adrift under these circumstances, nearly all the men noticed that their feet were becoming greatly swollen and numb; in addition they began to have a peculiar tingling and aching sensation in the soles. Some noticed similar symptoms in their hands, but of lesser degree. On finally being rescued, all were deeply tanned and many had developed cracks and small crusted lesions due to exposure to wind and salt water. When they came aboard the rescuing vessels most of the men found that walking on their swollen feet was difficult and that without support they lost their balance because of numbness in their feet and loss of sense of position. In addition, the majority complained of deep plantar tenderness and pain. On their arrival in port the men were all suffering from exhaustion, malnutrition, and dehydration.

The crew of lifeboat A were exposed to water at a temperature of around 50° during the last 2 days, when they sailed out of the warm water of the Gulf Stream and approached the coast. At this time the weather became stormy, they were forced to bail, and suffered from wet clothing and immersion of their feet in cold water. As a result of this exposure several of the men (cases 1, 6, 7, and 8, listed in table 1) developed cutaneous changes characteristic of exposure to cold (blebs and sluggish circulation in the cutaneous capillary bed with an increase in circulation through the deeper structures), but of a mild degree. The crew of lifeboat B were never exposed to water below the temperature of the Gulf Stream (70° to 80° F.) and showed no signs of cutaneous injury from cold.

TABLE 1.—Clinical data

Patient: Age	Edema	Cutaneous changes	Reflexes		Sensory change	Muscle tenderness	Pain	Stomatitis	Date of discharge	Comment
			K. J.	A. J.						
Lifeboat A										
Case 1 (20)	++	Superficial gangrene toe 5 (R). Superficial desquamation toes 1, 3, 4, and 5 (L).	+	+	Hypesthesia and tingling distal half of feet.	+	0	Severe	-----	General condition at first precarious. Semistuporous. Diarrhea.
Case 2 (26)	+	0	-----	-----	0	0	0	0	29 d.	Exercised his feet during period of dependency.
Case 3 (22)	Slight	Several small areas of cornification and desquamation.	++	+	0	0	0	Slight	31 d.	Do.
Case 4 (32)	Gone	0	+	+	Numbness at first when he walked. Hypesthesia wore off distally, disappeared in 3 weeks.	0	++	0	29 d.	Exercised feet while in lifeboat. Neuritis gone in a week.
Case 5 (35)	+	0	-----	-----	Hypesthesia receded to toes in 3 weeks.	0	0	-----	29 d.	Chest x-ray showed heart to be diffusely enlarged.
Case 6 (23)	++	Deep cracks and blebs in skin of soles, with eventual sloughing.	-----	-----	Difficult to evaluate due to language difficulties.	+	+++	0	-----	This West African Negro did nothing to keep in condition while adrift. Neuritis cleared in 5 weeks.
Case 7 (57)	+++	Desquamation and epidermophytosis. Hands also swollen at first.	+	+	Pain and sensory changes in hands for 2 weeks. Hypesthesia distal half of feet present after 3 weeks.	+	++	0	-----	Treated in pavex boot and edema subsided, but without relief of pain. This subsided after 5 weeks.
Case 8 (39)	+	0	+	+	Hypesthesia at first to ankles, but receded to toes in 3 weeks.	0	++	-----	-----	Neuritis subsided in 5 weeks.
Lifeboat B										
Case 9 (33)	0	0	-----	-----	0	0	Slight	Severe	14 d.	Exhausted and in poor general condition.
Case 10 (44)	0	0	-----	-----	Hypesthesia of toes; subjective in hands.	+	++	0	14 d.	Exhausted at first, but made good recovery.
Case 11 (50)	R: ++ L: +	0	-----	-----	Hypesthesia and paresthesia. Subjective changes in hands.	+	+	+	11 d.	Neuritis disappeared in 3 days.
Case 12 (35)	0	Superficial crusted lesions due to sun and windburn.	-----	-----	Sensation objectively normal, subjectively abnormal in hands as well as feet.	+	+	+	11 d.	Sensory disturbances had disappeared before discharge.
Case 13 (24)	Slight	0	-----	-----	Sensation objectively normal, subjectively abnormal in hands as well as in feet.	+	+	+	11 d.	
Case 14 (32)	0	0	-----	-----	Distal half of feet hypesthetic, hands to lesser degree.	+	+	0	11 d.	Neuritis disappeared in 3 days.
Case 15 (25)	0	0	-----	-----	Subjectively both hands and feet feel abnormal.	+	++	0	11 d.	Neuritis cleared quickly in hospital.

After examining these men it was at once apparent that their condition differed fundamentally from that of the survivors seen after rescue from the colder waters of the North Atlantic. Although both groups suffered from swollen and painful feet, these survivors of shipwreck in relatively warm water did not bear evidence of severe tissue damage in their feet, and they had other systemic disturbances of a very different nature. These consisted in some swelling and subjective sensory disturbances in their hands, as well as the more obvious changes in their feet; many of the men were also found to have glossitis and stomatitis, and additional gastro-intestinal complaints. The clinical findings observed in the entire series are summarized in table 1, the laboratory determinations in table 2.

EXPLANATION OF PATHOLOGICAL CHANGES

As has been brought out above, the chief complaint in both the northern and southern survivors was pain in the feet with swelling to the ankles or knees. The work of Lewis (1) proves that prolonged exposure to temperatures below 50° F. leads to edema from cellular damage and increased capillary permeability. Some direct tissue injury from cold undoubtedly occurred in the crew of lifeboat A during the last 2 days of their voyage, when they sailed close to the coast. But it is obvious that other reasons must account for the greater part of the swelling, which often extended to the knees, as well as the tenderness and other sensory changes which involved the feet and in some instances the hands as well. Other contributory factors which might account for these findings are the following:

1. *Continued dependency of the legs.*—In a crowded lifeboat, where all extra space on the thwarts and in the bilge is taken up with oars, water casks, and other boat gear, there is little opportunity to move the legs or to stow them in any but a dependent and cramped position. It is a well-known fact that hypostatic edema invariably develops under such circumstances, due to increased filtration pressure in the capillary bed, decreased absorption in the venous ends of the capillary loops, and reduced lymphatic return (2). In addition there may be maceration of the skin when it is constantly wet, but actual edema cannot result from prolonged soaking in salt water alone. In many of the men the feet became so swollen that they were forced to remove their shoes or cut holes in them, but the edema never became as pronounced as in the northern survivors, in whom there was the added factor of anoxia from capillary stasis and inflammatory changes from superimposed thermal injury.

2. *Hypoproteinemia.*—In view of the fact that the men in each lifeboat were unable to swallow much solid food and that they were called upon to burn up large amounts of energy which had to be

derived from their own tissues, it is not surprising that many were found to have a low serum protein. The lowest levels recorded were 3.3 and 5.1 in cases 1 and 7. Cases 9 and 10 might well have shown levels lower than 6.0 and 5.6 if further observations had been made after the restoration of fluid balance. If all these patients had been tested it is probable that more cases of hypoproteinemia would have been discovered. The low albumin-globulin ratio in cases 1 and 7 is of particular significance. In an attempt to produce nutritional edema experimentally, Jones, Eaton, and White (3) fed cats on a diet deficient in nitrogen for a period of 4 to 5 weeks. At the end of that time there was no striking swelling of the legs while the animals were maintained on a limited intake of water. However, when fluid and salt were given in normal amounts edema developed to a striking degree. The chances are that the swelling visible in the legs of these men was less marked while they were adrift and on a critically low intake of water, and that it increased greatly after rescue as they were enabled to restore their depleted tissue fluids.

3. *Vitamin deficiency*.—Edema due simply to dependency and hypoproteinemia is not commonly considered to be a cause of sensory changes.² Therefore it is not likely that the pain and tenderness of the feet and the hypesthesia of these parts, as well as the subjective sensory loss in the hands, developed on this basis alone. Can these symptoms be accounted for by a deficiency in the antineuritic factor in the vitamin B complex, as is so frequently the case in alcoholic neuritis? According to Brain (4), "in the early stages the patient complains of numbness, tingling, and paresthesiae in the hands and feet, and especially pain in the extremities." Ataxia, which most of these men noticed when they were rescued, is conspicuous. The tendon jerks, which may at first be hyperactive, are diminished or lost in the advanced stages, the ankle jerks disappearing before the knee jerks. Examination of the reflexes in these subjects showed normal responses in the four patients tested. This is incompatible with the advanced type of neuritis due to long-standing avitaminosis, but in no way rules out the earlier stages which might occur in such a relatively brief period.

Further clinical findings which suggest an avitaminosis are the oral lesions. Cases 1, 3, 9, 11, 12, and 13, reached the hospital with a nonspecific stomatitis. This consisted of superficial vesicles and ulcers of the tongue, buccal mucosa, palate and pharynx. In cases 1, 9, and 12, the sides of the tongue were smooth and reddened, and case 13 had suffered from bleeding gums. It is also of interest to note that in 6 out of 8 patients where the feces were examined with

² This idea has, however, been questioned by Youmans. In a personal communication he tells me that patients with nutritional edema may have distinct pain and tenderness, particularly if the swelling develops abruptly.

the guaiac and benzidine reagents, the tests were at first positive for occult blood (table 2, cases 1, 10, 11, 12, 14, and 15). It is of further interest to point out that in the 3 patients where prothrombin times were determined, there was an increase beyond the normal period of 20 seconds to 40, 27, and 25 seconds. This denotes a definite deficiency in vitamin K, which reached a severe degree in case 16. This man in addition became severely exsanguinated from gastric bleeding, which finally necessitated surgical intervention. One other survivor, who had been rescued after a long period adrift in warm water, also suffered exsanguinating gastric hemorrhages. It is possible that this bleeding from the gastro-intestinal tract, as well as the stomatitis, may be related to nicotinic acid deficiency, as ulcerations may occur at any level in the gastro-intestinal tract in the deficiency states.

The work of Crandon, Lund, and Dill (5) has shown that in an individual leading an indoor existence, it takes over 4 months to produce clinical scurvy on a minimum low diet of vitamin C. Alcoholic neuritis is not known to occur in any such brief period as a fortnight, and in fasting subjects who have been studied for even longer periods sensory changes in the extremities have not been recorded, but these observations have been made on inactive individuals. It is significant that at the recent meeting of the American Association of Physicians at Atlantic City, Youmans (6) reported the development of riboflavin deficiency within a short period in men working in intense sunlight.³ The fact that thiamine, nicotinic acid, and riboflavin play an active chemical role in the oxidation of glucose may explain their rapid depletion under the circumstances. A depletion of the antineuritic and other components of the B complex is, therefore, a distinct possibility. It is also possible that the men who suffered the most may have been in a partially depleted state before their ships were torpedoed and their vitamin intake stopped, although I was unable to discover any evidence of this.

Although the deficiency theory seems to me to be the most plausible explanation for the sensory changes which occurred in the absence of actual injury from cold, proof of its correctness must depend on further observations. Confirmative evidence can be obtained by a therapeutic trial of thiamine chloride and other fractions of the vitamin B complex. The response to this which was subsequently

³ In a recent letter Dr. John B. Youmans has been kind enough to give me the following pertinent data: He has observed that "patients with nutritional edema very frequently develop pain and tenderness, and sometimes superficial inflammation (erythema), particularly when the onset is rather abrupt. * * * With a very restricted diet and with hard work, some deficiencies such as B₁ are believed to develop evidence of the deficiency within a week or so. * * * The stomatitis and glossitis may well represent a combination of a deficiency of the B complex, including riboflavin plus dehydration. Dehydration is quite important as there is evidence that this precipitates the syndrome of pellagra."

TABLE 2.—Available laboratory data

Patient	Date	Urine: Specific gravity	Blood										Feces: Occult blood
			R. B. C.	Hgb.	W. B. C.	Serum			Urea N.	Plasma chloride	Ascorbic acid	Pro- throm- bin time	
						Protein	Alb.	Glob.					
Case 1	4/15/42	1.025		Gm.			Percent	Percent	Percent	Mgm. percent	Mgm. percent	Seconds	+
	4/16/42		4,000,000	15.3	12,300		5.4	3.5	1.9				
	4/20/42	1.019	3,810,000	13.3	10,900		3.3	1.7	1.6				
	4/27/42	1.018					4.8	2.8	2.0				
	5/7/42						5.4	3.3	2.1				
Case 2	4/15/42	1.030	5,580,000	13.7	8,700								
	4/17/42												
Case 3	4/15/42	1.018	5,890,000	13.3	15,100								
	4/17/42												
Case 4	4/15/42	1.025	4,630,000	16.4	5,400								
	4/17/42												
Case 5	4/15/42	1.025	5,090,000	14.0	9,600								
	4/17/42												
Case 6	4/17/42		3,630,000	10.5	13,900								
	4/24/42		4,350,000	11.0	8,300								
Case 7	4/15/42	1.025	4,990,000	13.3	10,000								
	4/17/42						5.1	2.4	2.7	13.3	770		
	4/18/42												
Case 8	4/15/42	1.020	4,060,000	12.9	6,900								
	4/17/42												
Case 9	5/8/42						6.0			410	1.98	27	0
Case 10	5/8/42	1.012	4,680,000	12.4	15,600					390	1.82	25	+
	5/9/42		5,050,000	12.1	6,900		5.6						0
	5/13/42												

Case 11	5/8/42 5/9/42 5/14/42	1.023					+ 0
Case 12	5/8/42	1.014					+
Case 13	5/8/42	1.023					0
Case 14	5/8/42	1.025					+
Case 15	5/8/42	1.029					+
Case 16, not included in this study because he had just been operated upon for gastric hemorrhage, had highest prothrombin time observed							40

The above figures do not show the striking alterations in the blood and urine which go with severe dehydration, but it must be remembered that these men had already had up to 24 hours to restore their depleted body water reserves before most of the above determinations could be made. Other compensatory factors must also be taken into account. Although only cases 2 and 3 show a definite erythrocyte concentration, the anemia that goes with starvation would counterbalance this. All of the serum protein levels are low, and would probably have fallen lower, as was the case with case 1, if further estimations, had been made after water balance had returned to normal levels. Half of the patients still had a concentration of urinary specific gravity of 1.025 or higher after nearly a day's unlimited access to water. The blood urea nitrogen level of 24 mgm. in case 1 is distinctly elevated and the figure of 13.3 mgm. in case 7 is not significant, as it was not obtained until 3 days after rescue. Loss of blood electrolytes was pronounced in cases 9 and 10. This was presumably caused by excessive sweating with a low salt intake, whereas case 7, who had drunk salt water, had a very high level. The ascorbic acid figures (cases 9 and 10) are not reduced.

obtained in these patients was suggestive of the correctness of this hypothesis, but much further investigation should be planned on future survivors who must continue to come in to our naval and public health hospitals. When the opportunity presents, such patients should be routinely investigated as outlined below and should be seen by consultants who have had a large experience in treating cases of beriberi, pellagra, and alcoholic neuritis.

TREATMENT

The first requisite for intelligent treatment is an accurate appraisal of alterations which have taken place in the normal levels of electrolytes, proteins, and vitamins. Inspection of the tongue and measurement of the volume of urinary secretion and specific gravity are the simplest and best tests to detect early changes in water balance, whereas determination of the erythrocyte count, hemoglobin, hematocrit, serum protein, and non-protein nitrogen are the most valuable laboratory methods for estimating severe degrees of dehydration (see table 2). In treating shipwrecked survivors who have been exposed to intense heat, it is also important to know the serum chloride and sodium values, when possible, as there may be a serious loss of these electrolytes from sweating (cases 9 and 10). In view of the frequent presence of occult blood in the stools, these should be routinely tested and the prothrombin time determined when the guaiac reaction is positive. Diarrhea and depleting loss of blood from the gastro-intestinal tract may be a serious risk in these cases.

In the restoration of fluid balance it is important to replace protein and salt simultaneously with water if these essential components of the blood are depleted. Unless this is done much of the water drunk will be lost by diuresis, edema will be increased (3), and severe cramps may be produced (7). Therefore it is best to give water only in limited quantities after rescue until some idea of the actual deficiencies in protein and salt can be obtained. Sodium chloride can easily be replaced by mouth if the blood level is only slightly reduced, or by infusions of normal saline solution if the depletion is great.

The treatment of hypostatic and nutritional edema is well standardized. Swelling due to simple dependency of the legs and lymph stasis disappears rapidly on elevating the foot of the bed and exercising the feet. With the added factor of starvation it is important to restore the deficiency in protein in order to raise the osmotic pressure of the blood. This can be accomplished satisfactorily by transfusions of plasma or, more effectively still, by the use of pure human or beef albumin. The synthesis of blood proteins in the body is facilitated by a diet high in protein and can be still further

accelerated by intravenous administration of amino-acids, as recommended by Elman and Weiner (8).

Vitamin deficiencies in these survivors require further study. Much can be learned by making a special examination of men who have been adrift for long periods and who have developed unusual epithelial lesions and neurological changes. This should include a careful scrutiny of:

1. The sclera with the slit-lamp for evidence of peripheral vascularization, and of the lips and angles of the mouth for cracks characteristic of riboflavin deficiency.
2. The tongue and buccal mucosa for evidence of nicotinic acid or riboflavin deficiency and for evidence of extreme dehydration.
3. The deep reflexes of the extremities (especially the ankle jerks) which may be diminished in thiamine deficiency.
4. Sensory examination of the extremities to see if there is abnormal diminution of sensation in the hands and feet, loss of position and vibration sense, or tenderness on pressure over the nerve trunks and soles of the feet.

As has been brought out above, some but not all of these clinical signs of vitamin B deficiency were present in the southern patients. Unlike the more severe thermal injuries suffered by the survivors of vessels torpedoed in the North Atlantic, where vascular thrombosis and sepsis may necessitate amputation, the peripheral lesions were not serious and required over a fortnight's hospitalization in only six cases. With the exception of the two cases of gastric hemorrhage, which are outside the scope of this report, the most incapacitating symptoms were the neuritic pains in the feet. Whether due to specific action or merely coincidentally, the pain and tenderness disappeared in 2 to 4 weeks on vitamin B therapy. In treating future cases, naval medical officers should first place such patients on a therapeutic test of vitamin B in large amounts, giving daily intramuscular injections. If the response is favorable it will go far to establish the diagnosis of vitamin B deficiency. Once this point has been settled, a less expensive therapy consisting of brewer's yeast (which contains large amounts of all the B components) and a diet of green vegetables, carrots, butter, and liver can be substituted. Furthermore, if this theory is substantiated, it will be wise to add to the lifeboat rations a supply of vitamin B in simple form for the prevention of neuritis, sensory changes, and lesions in the gastro-intestinal tract. The least expensive and most suitable preparation which comprises all the components of the B complex is brewer's yeast in compressed tablets. On the other hand, if vitamin therapy is without consistent benefit, this theory must be discarded and a better explanation sought.

In addition to the systemic treatment which has been outlined above, local physiotherapy and Buerger's exercises should be of help in accelerating recovery.

CONCLUSIONS

1. The painful swelling of the feet observed in two lifeboat crews, adrift for prolonged periods in the South Atlantic, had fundamental clinical and etiological differences from the "immersion foot" syndrome which so often develops in the survivors of vessels torpedoed in the colder waters of the North Atlantic.

2. Both groups of men had edema of the feet due to prolonged dependency and immobility.

3. In the case of the men torpedoed in the North Atlantic, additional swelling and neuritic pain were caused by direct injury to the skin, cutaneous capillaries, and nerves by immersion in cold water.

4. Immersion in warm water *per se* cannot account for either edema or pain in the legs and feet. Therefore the syndrome observed should not be classified as "immersion foot."

5. In most of the men who were adrift for long periods in the Gulf Stream, direct thermal injury can be excluded (at least in the crew of lifeboat B). Hypoproteinemia from starvation was an additional cause of swelling in these survivors. Edema of this type is not generally considered to be painful. It is postulated, but not proved, that the stomatitis, sensory disturbances in the hands and feet, and plantar tenderness, which developed in these patients, were caused by a deficiency of the antineuritic factor and other components in the vitamin B complex. Evidence is quoted to show that such a deficiency may occur at a greatly accelerated rate in the rapid tissue oxidation reactions which take place in men who are forced to do hard physical work in a hot climate.

6. An added deficiency in vitamin K was found in 3 cases where the prothrombin time was determined and loss of blood in the stools was a common occurrence.

7. The possibility that vitamin B and K deficiency may develop in such a brief period as 2½ weeks has not heretofore been suggested.

I wish to express particular thanks to Capt. W. S. Bean, United States Public Health Service, and the staff of a United States marine hospital on the Atlantic coast for their kindness and cooperation. All available data were put at my disposal in the hospital and much additional information on the progress of these patients sent by mail after my departure.

Much further help and advice in preparing this paper has been given me by Dr. Nicholas Gotten of the University of Tennessee, Memphis, Dr. J. B. Youmans of Vanderbilt University, Nashville, and Dr. C. M. Jones of the Massachusetts General Hospital, Boston.

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HYGIENE FOR AVIATION PERSONNEL IN AIRCRAFT CARRIERS¹

By C. C. YANQUELL, Commander, Medical Corps, United States Navy

Under war conditions the hygiene of the naval aviator must embrace the fact that he is apt to be ship-based for long intervals. A consideration of the mechanism of this adjustment is somewhat of a special chapter of preventive medicine. The success of his particular mission is interwoven with many apparently inconsequential details of his living conditions. Satisfaction in food, rooms, recreation, and medical care looms large in his life and does much to offset the damage of hard, exacting work pushed to the limit of endurance.

The truism that the aircraft carrier's only function is to base and fly the aircraft squadrons must be nicely balanced by the medical officer in his dealings with the whole ship's company. Any sharp demarcation of medical care for the flying personnel should be avoided. The flight surgeon is a specialist who fits into the little group of other medical specialists forming the medical department of the carrier. He is not set aside from them nor is he self sufficient. It is often considered better in larger carriers to place him in the eye, ear, nose, and throat department rather than refer the entire aviation sick call to him. His contact with the pilots will not be lost by this plan. With the cooperation of his colleagues he will see all cases requiring his advice. The patients appear to react well to the fact that the ship has a small hospital within it, staffed by doctors specially trained in the essential branches of medicine and surgery. At the same time they know that the flight surgeon is always available for their own problems, and there is no loss of the patient-physician relationship.

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The majority of aviators appearing at sick call will be the immediate concern of the flight surgeon because of eye, ear, nose, or throat conditions. The rigid visual requirements for admission are paying dividends in the relative lack of ocular complaints, but in the tropics a certain number of individuals will develop conjunctival irritation or headaches from sun glare. The oft-debated question of whether these pilots should wear tinted lenses when flying is usually settled by the aviator himself securing the standard Navy Calobar goggles or some commercial variety. Many oculists consider that there is little danger of loss of visual purple regeneration if the colored lenses are worn only when flying in excessively bright sunlight. The flight surgeon may check them for undesirable features such as refraction and the masking of terrain. In the end the pilot's comfort is usually the deciding factor; if he flies more efficiently with the antiglare lenses he probably should have them prescribed.

The importance of a palatable, appetizing, and well-balanced diet to the healthy young man can hardly be overestimated. As a morale sustainer for a tired aviator there is little that can compete with a well-prepared and served dinner. The food of the pilot usually must conform to that of the wardroom's menu, which is often governed by the wishes of older gourmets and epicures, but it is not difficult to secure the mess treasurer's help in maintaining an attractive, plain-food bill of fare. The menu of the general mess ordinarily offers a good example of balance.

The vitamin content of the meals can be quite adequate, requiring no fortification. However, because of the present awareness of the connection of diet and night blindness, an added supply of food such as raw carrots and other yellow vegetables is desirable. Any real avitaminosis is scarcely to be expected among the younger groups of combat flyers. When a pathological reduction of dark adaptation is suspected, some rough tests can be made in the sickbay's dark-room. In the absence of an adaptometer or other precise night blindness detecting device, the patient may be directed to look steadily at a 50-watt light 10 feet distant, for 2 minutes, after which the lights are dimmed and he is asked to read a line on the eye chart, previously determined by tests with normal individuals, and his speed and accuracy noted. Before a diagnosis of defective dark adaptation is charged to dietary deficiencies, the subject's habits as to tobacco and coffee consumption must be investigated. As regards vitamin medication, not only is the administration of pills and capsules undesirable to young, actively flying pilots, but the efficacy of such treatment in correcting the food deficiency within a few days is questioned by authorities. Individual dietary whims leading to measurable

night blindness symptoms will not likely be encountered among carrier pilots.

Of considerable importance, however, with altitude flying, is the elimination, as far as practicable, of foods liable to cause excessive intestinal gas, and some of the more common of the potentially allergic food materials. It is well worth the medical officer's time to gain a reputation with the food handlers of being an unusually critical sanitation inspector. The prevention of an outbreak of gastro-enteritis may be the reward.

Shipboard exercise and recreation for flying personnel are not particularly hard to accomplish in an aircraft carrier, where the hangar deck provides considerable space. Competitive games such as volleyball, basketball, and badminton are encouraged. Softball (baseball), medicine ball, wrestling, and boxing are undesirable because of the high incidence of minor injuries. The indolent and the diffident may need coaxing to exercise and these are usually the types who benefit most from it. The flight surgeon's knowledge of the age and physical condition of the pilots must be utilized in his efforts to secure the proper kind of exercise. Best results are usually obtained by refraining from any obvious directing of games and banishing the appearance of drill or organization. Strenuous flying calls for little other exercise for the already wearied flyer, and the extremely conscientious man may need some advice along this line. Excessive fatigue sometimes produces the paradoxical condition of restlessness. Relaxation, in the tropics, with sunbathing, is admirable in easing such nervous tension.

Satisfactory ventilation, heating, and cooling of the pilots' "ready" rooms are rather difficult to obtain under battle conditions. With a dozen or more individuals in the small room awaiting combat instructions, closing the ship's gas-proof envelope causes discomfort. Air conditioning machines are of marked assistance, although the theory that cooling and movement of rebreathed air overcomes the disagreeable effects of vitiation is not universally applicable. Some aviators complain of lassitude and headache upon arriving at their planes on the flight deck following the "man-your-planes" order. Whether a whiff from the plane's oxygen tank at that time is advisable is quite controversial; the flyer's reactions just then are of utmost importance and any recommendations for therapy should be delayed, along with attempts at hyperventilation by the pilot. In general the aviator's own adaptive mechanism should be permitted to function without adding any more maneuvers to his already well occupied mind.

A frequent question for the flight surgeon to decide is whether to ground a pilot with afebrile coryza in order to prevent the myringitis

or eustachian salpingitis which are particularly apt to occur after divebombing. An arbitrary interpretation of the dictum that no one with a cold should fly would often cripple a squadron. The type of duty and the patency of the eustachian tubes are two deciding factors. Fighters and bombers should be grounded with tubal blocking. Torpedo pilots can often fly with no damage. Relief of the sinus-vacuum headache which follows flights with an upper respiratory infection can be secured with oxygen inhalations in the sickbay somewhat more easily than with topical applications and sedatives.

The usual result of long-continued aerial insults to the ear, in the presence of any chronic upper respiratory infection, is permanently defective hearing. The loss is temporary at first, and need not be accompanied by drum involvement. The flyer notices progressive hearing impairment, beginning with a temporary defect after each hop, which refuses to clear up entirely. Protection with cotton in the external canals retards the process a bit; if vaseline-impregnated cotton is used, it may be considerably more effective. Eventually, the pilot complains of a high, piercing tinnitus while flying which may fail to clear up entirely, and at this time the audiometer tests will show the characteristic curve of nerve-deafness. Some conduction loss of hearing is also present from the continual low grade myringitis and aural tube infection.

The prophylaxis of serious hearing defects obviously is connected with the regulation of flying while suffering from predisposing conditions. One finds fewer aviators with defective hearing now than in the post-war decade, possibly due to more careful physical selection, since the airplane noise has increased in volume most assuredly. Some of these younger pilots have flown for several years with no serious attempt at ear protection and the almost universal wearing of ear-phones discourages the necessary cotton. Rarely is there any loss of hearing found in these people by the ordinary test methods, and tinnitus is just as uncommon. There is, probably, an individual idiosyncrasy since several cases of passengers receiving permanent, severe hearing impairment following their first flights have been reported. Interruption of a pilot's flying career is indicated if the tinnitus and hearing loss are progressive.

Recommendation by the medical officer for removing a pilot temporarily from flight status should be promptly and clearly made to the squadron commander concerned. Last minute groundings, when the planes are already in flying position on the flight deck are a cause of considerable extra work for the flight officer in securing a relief pilot or in respotting the ailing aviator's plane. Such incidents are sometimes unavoidable, but energetic action by the flight surgeon can

prevent unnecessary delay in the receipt of the word. There should be no hesitancy in explaining the physical condition of the grounded pilot to his squadron commander, and there need be no breach of medical ethics. Admission to the sick list may not be required, but most certainly the aviator should not be returned to full duty until the indicated physical examination has been done.

Protracted cruises in hot climates tend to make significant and characteristic changes in circulatory efficiency ratings, out of proportion to the amount of flying being done. The systolic blood pressure is lowered and there is little or no rise upon standing. This vasomotor relaxation is, of course, physiological, and is aggravated by the excessive heat and humidity of the ship's aviation examining room. It is not a true orthostatic hypotension. However, any standing systolic fall below the reclining systolic pressure should always be viewed with suspicion, regardless of climatic influences.

The prevention of effort syndrome, cumulative fatigue, and of neuroses among aviators is a major portion of the indoctrination of flight surgeons, and in the aircraft carrier his prophylactic measures may be earlier applied. He will find that the prospect of battle will add no elements of apprehension or anxiety which can be called pathological. The aviator who is making almost daily carrier landings has already built up a mental defense which is nearly impenetrable to morbid fears, else his carrier career would have been terminated shortly after his qualification landing. The special selection, age group, and physical condition of combat pilots operate strongly against the appearance of aerial neuroses and effort syndromes, but the presence of cumulative fatigue is not particularly uncommon.

The fatigue is neuromuscular in origin, and symptoms of lack of normal recovery from physical exertion, under mental strain, predominate, as might be expected. Ocular asthenia and spastic muscular pains are among the first signs to appear; an ordinary night's sleep does not repair the injury and the end products of systemic fatigue increase. It may be noted in passing that this condition of increasing exhaustion need not be considered an occupational affection of aviators alone. Without remedy, the fatigue syndrome usually passes on to the vasomotor disturbances of effort syndrome, or to the increased psychomotor activity, irritability and gastro-intestinal complaints of the anxiety neurosis, depending upon the balance of neuromuscular reserve for its pathway. Only then can it really be labeled an abnormal response to effort.

The diagnostic refinements, aboard ship, must give precedence to prevention and treatment of fatigue conditions and their sequelae. One cannot remove a pilot entirely from his environment as a special therapeutic measure; sick or well he must continue to live for the time within the intense activities of aviation, whether he flies or not.

His morale and loyalty seldom permit him to admit that he is being slowed by excessive flying, and there is good reason for not trying to convince him that such is the case. Early recognition, tactful handling, and such rest and other treatment as an actively operating carrier can afford will prevent the emergence of a neurosis.

The foregoing remarks are not intended to separate the shipboard hygiene of the aviator from the general subject of aviation medicine. Their purpose is to discuss certain problems of carrier-based naval aviators which should be the concern of the medical officer and to offer solutions based on practical experience.

POSTURAL CHANGES IN STANDING BLOOD PRESSURE AFFECTING THE AVIATION CIRCULATORY EFFICIENCY RATING¹

By CHARLES F. GELL, Lieutenant, Medical Corps, United States Navy

In conducting the circulatory efficiency test (1), which is a routine part of the aviation physical examination, several possibilities of error are present if the test is not conducted exactly as prescribed in the Manual of the Medical Department. These errors may be avoided, however, if care is taken in conducting the test. There is, unfortunately, one phase of the circulatory efficiency test for which no definite written instructions are given as to method, which if conducted haphazardly may result in an erroneous score. This part of the test in question is the evaluation of the standing blood pressure and the position of the examinee's arm in relation to his body when it is taken.

Numerous observers have noted that, when the blood pressure is taken with the patient standing, the systolic and diastolic pressures change, in the majority of cases, when the arm is lowered from the horizontal to the pendent position. In general, as the arm is lowered, the systolic and diastolic pressures will increase, with the diastolic increase being the greater of the two. Berry, Horton, and MacLean (2), in their study of postural responses to blood pressure, found that in a group of normal subjects a range of pressure change of 16 mm. of mercury in the systolic reading and 19 mm. of mercury in the diastolic reading was obtained in the erect postures by moving the subject's arm from the pendent to the horizontal position.

This phenomenon is explained in the following manner: When the arm is supported at the level of the heart, the pressure of the

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column of blood ascending from the heart to the axillary artery and that descending from the axillary artery in the arm are about equal. Hence, the hydrostatic action of gravity is equal on both columns of blood and it does not influence the blood pressure in either column. If the arm is held in a horizontal position above the level of the heart, however, the hydrostatic action of gravity is greater on the column of blood between the heart and the axillary artery and the blood pressure in the arm will decrease. Conversely, if the arm is held below the level of the heart, the gravitational pull is greater on the column of blood in the arm and the blood pressure reading increases.

The American Heart Association (3) recommends that when the sitting blood pressure is taken, the arm should be held at the level of the heart, but it has made no recommendation in regard to standing blood pressure readings. It seems obvious, however, that the arm should be held in the same manner when the erect position is assumed in order to get a true reading.

The author has observed, after 4 years' experience, that there is a great variation in the position in which the examinee's arm is held for standing blood pressure readings by different examiners for the circulatory efficiency test. If the examiner is tall and the subject short, the arm is usually held in the horizontal, or above the horizontal, position. If the statures of the participants are reversed, the arm is usually held in a more pendent position. In any event, it has been noted that the arm very often is not held in the position presumed to be correct—level with the heart.

Considering the above factors, the author became curious as to what effect the changes in blood pressure, caused by varying the position of the arm when standing blood pressures were taken, would have on the ultimate score of the circulatory efficiency test. A simple variation in procedure was planned and carried out on the ensuing 50 circulatory efficiency tests conducted on applicants for flight training. The reclining pulse and blood pressure were taken in the usual manner. The subject then stood quietly erect for 2 minutes followed by a check of his pulse. His blood pressure was then taken three times: First, with the arm in the horizontal position above the level of the heart; second, with the arm level with the heart; third, with the arm pendent. The test was then concluded in the usual manner. Three computations of the score were then made, each one considering a different standing blood pressure. In analysing the blood pressure readings only the systolic pressures were considered, because the diastolic pressures do not enter into the computation of the circulatory efficiency rating.

Arm position for standing blood pressure

Case No.	Resting pulse	Resting blood pressure	Standing pulse	Horizontal blood pressure	Heart-level blood pressure	Pendent blood pressure	Pulse after exercise	Return to standing pulse	Circulatory efficiency rating score		
									No. 1	No. 2	No. 3
1	87	118/68	100	112/60	118/72	128/76	116	30	+6	+8	+10
2	84	118/50	92	96/64	116/60	118/60	100	45	+7	+8	+9
3	81	106/62	104	104/58	110/68	112/88	120	30	+4	+6	+6
4	60	120/72	84	108/62	108/66	112/72	108	45	+9	+9	+9
5	75	122/70	100	98/72	118/70	118/68	128	75	+3	+4	+4
6	81	106/68	100	106/62	106/64	108/68	116	60	+5	+5	+6
7	78	118/60	86	98/60	108/66	108/68	112	45	+9	+9	+9
8	96	122/64	112	124/78	124/80	130/80	120	45	+5	+5	+6
9	72	120/70	92	92/66	118/80	118/84	116	45	+4	+5	+5
10	69	105/60	80	85/60	107/84	110/82	112	30	+10	+13	+13
11	78	118/62	96	100/64	118/68	114/78	112	45	+7	+9	+8
12	78	106/66	96	100/56	108/72	110/76	116	60	+7	+10	+10
13	74	124/76	96	120/74	126/82	126/80	116	60	+6	+8	+8
14	84	108/64	100	105/60	110/68	112/76	120	60	+6	+8	+8
15	72	112/62	90	110/62	112/62	112/62	120	60	+9	+10	+10
16	78	110/60	92	108/68	110/78	112/80	116	60	+7	+8	+9
17	76	108/58	94	110/58	108/58	108/58	112	45	+10	+9	+9
18	78	118/72	100	108/68	118/80	124/88	116	30	+6	+8	+9
19	69	114/72	80	104/64	114/72	122/78	96	30	+12	+14	+16
20	93	108/64	108	100/60	110/78	108/68	116	30	+4	+7	+6
21	87	112/74	92	102/72	112/80	114/80	114	45	+5	+7	+8
22	78	112/66	92	100/60	98/62	98/62	112	60	+7	+7	+7
23	64	110/64	68	112/64	112/64	114/68	88	30	+17	+17	+17
24	70	128/70	88	130/74	130/74	128/78	96	30	+15	+15	+14
25	64	130/60	72	130/72	130/72	130/74	92	45	+14	+14	+14
26	66	112/68	88	104/68	106/70	106/70	100	30	+10	+10	+10
27	81	122/60	88	104/60	110/68	122/66	116	45	+7	+7	+9
28	84	110/64	96	106/76	116/80	116/80	120	75	+4	+6	+6
29	63	110/58	80	104/64	106/78	118/78	104	30	+11	+12	+15
30	60	110/60	72	98/60	106/60	104/68	104	45	+10	+11	+10
31	64	120/70	68	104/70	120/68	110/70	92	30	+13	+15	+13
32	78	114/64	84	100/70	110/70	112/80	136	60	+7	+8	+8
33	93	120/70	112	110/66	122/80	126/88	120	60	0	+3	+3
34	75	104/64	112	100/60	104/70	106/70	128	60	+1	+2	+3
35	76	118/60	84	108/52	118/64	118/64	108	45	+9	+11	+11
36	80	112/70	92	104/64	110/72	118/78	108	30	+8	+9	+11
37	63	108/60	72	108/60	110/66	110/68	80	30	+16	+17	+17
38	54	110/56	76	100/60	104/62	98/70	96	30	+12	+12	+12
39	80	112/68	92	100/64	114/74	104/70	112	45	+7	+10	+7
40	87	116/60	88	108/68	120/70	128/78	120	45	+6	+9	+10
41	81	116/80	96	102/58	114/68	114/70	104	30	+7	+8	+8
42	66	106/64	80	98/58	100/68	106/72	112	45	+9	+9	+11
43	60	106/58	84	96/60	106/64	112/76	96	30	+11	+13	+14
44	75	114/60	92	104/60	114/68	114/78	108	45	+7	+9	+9
45	78	106/72	88	94/66	104/68	108/76	96	45	+11	+12	+14
46	93	130/78	108	125/80	135/88	135/90	128	45	+3	+5	+5
47	87	128/64	92	104/50	132/76	134/84	112	60	+6	+9	+9
48	81	118/74	108	96/62	126/78	128/84	116	30	+3	+7	+7
49	72	106/66	84	94/60	106/70	110/74	108	30	+9	+11	+12
50	72	110/66	80	114/70	118/74	122/74	104	60	+13	+14	+14

ANALYSIS OF STANDING SYSTOLIC BLOOD PRESSURES

1. Progressive increase as the arm was lowered from the horizontal to the pendent position—24 cases.
2. Increase when the arm was lowered from the horizontal to heart level, but no further increase when arm was lowered to the pendent position—12 cases.
3. Increase when arm was lowered from the horizontal to heart level and a decrease when the arm was pendent with the pendent pressure greater than the horizontal—5 cases.
4. Increase when the arm was lowered from the horizontal to heart level and a decrease when the arm was pendent with the pendent pressure less than the horizontal—1 case.
5. No pressure change in any position—1 case.

6. No rise when the arm was lowered from the horizontal to heart level but a rise when the arm was dropped from heart level to pendent—4 cases.

7. No rise when the arm was lowered from the horizontal to heart level, with a fall when the arm was lowered from the heart level to pendent—1 case.

8. A fall in pressure when the arm was lowered from horizontal to heart level with no change when the arm was lowered from heart level to pendent—2 cases.

ANALYSIS OF THE CIRCULATORY EFFICIENCY SCORE CHANGES IN RELATION TO THE PREVIOUSLY SUMMARIZED STANDING SYSTOLIC PRESSURE CHANGE

1. No change in score—7 cases.

2. Progressive increase in the score as the arm was lowered—13 cases.

3. Horizontal and heart level position scores equal with an increase in the pendent position—4 cases.

4. Increase in score from horizontal to heart level position. No further increase in pendent position—20 cases.

5. Increase in score from horizontal to heart level position with a decrease in the pendent position. Pendent score greater than the horizontal score—2 cases.

6. Increase in score from horizontal to heart level position with a decrease in the pendent position. Pendent score equal to the horizontal score—3 cases.

7. Horizontal and heart level scores equal with a decrease in the pendent position—1 case.

ANALYSIS OF THE CIRCULATORY EFFICIENCY SCORE CHANGES

1. Forty-three out of 50 cases demonstrated enough systolic pressure change in the three standing positions to cause a variation in their circulatory efficiency test scores.

2. Thirteen failed to get a passing score with the arm at horizontal position but passed when the blood pressure taken with the arm at heart level or pendent was considered.

3. One failed when the pressures at horizontal and pendent were considered but passed when the pressure at heart level was considered.

4. Two failed when the pressures at horizontal and heart level were considered but passed when the pendent pressure was considered.

5. A total of 16 borderline cases failed when the horizontal pressure was considered in evaluating their score but passed when the heart level or pendent pressure was considered.

SUMMARY AND CONCLUSIONS

1. When blood pressures are taken with the subject in an erect position, an increase in the systolic and diastolic pressures will generally be manifested as the arm is lowered from the horizontal to the pendent position.

2. This variation was great enough to change the scores in 43 of 50 routine circulatory efficiency ratings when the standing blood pressure was taken: First, with the arm horizontal or above the level of the heart; second, with the arm at the level of the heart; third, with the arm pendent.

3. Sixteen borderline subjects failed to get a passing score in the Circulatory Efficiency Test for Aviation when the standing systolic blood pressure taken with the arm horizontal was considered in the test, but gained a passing score when the arm was held at the level of the heart or in a pendent position.

4. In view of the above possible variations, it is believed that a standard position for the arm should be maintained when the standing blood pressure is taken for the circulatory efficiency test. This position appears to be that in which the hydrostatic action of gravity on the blood column in the arm and from the axillary artery to the heart are equal. This condition appears to be satisfied when the arm is held at heart level.

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BORDERLINE HYPERTENSION AND THE NAVY DURING THE EMERGENCY ¹

INCIDENCE OF HYPERTENSION AMONG THE GENERAL POPULATION

By ARTHUR M. MASTER, Commander, Medical Corps, United States Naval Reserve

The importance of incipient hypertension in the naval forces can not be exaggerated. Hundreds of applicants are examined daily because of the emergency and not a day passes but the medical examiner is confronted with the question of rejecting a candidate who is otherwise perfectly normal, often of unusually fine physique, whose blood pressure tends to be somewhat elevated. He is often sent from one examiner to another and finally to a cardiologist; his mental tension increasing and concurrently his arterial tension!

The Manual of the Medical Department of the United States Navy, paragraph 1490, states that a cause for rejection of applicants for enlistment is a:

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Hypertension evidenced by a persistent systolic blood pressure above 150. In persons under 25 years of age a persistent systolic pressure of or above 140 or a persistent diastolic pressure of 95 or over before or after exercise, is a cause for rejection.

Paragraph 1483 reads:

In considering the blood pressure, due regard must be given to the age of the applicant and to physiological causes, such as excitement, recent exercises, and digestion. The condition of the arteries, the tenseness of the pulse, and the degree of accentuation of the aortic second sound must be taken into consideration, as will also the relation between the systolic and diastolic pressure. No applicant will be rejected as a result of a single reading. When the blood pressure estimation at the first examination is regarded as abnormal, or in case of doubt, the procedure will be repeated twice daily (in the morning and in the afternoon) for a sufficient number of days to enable the examiner to arrive at a definite conclusion.

A man of 43 in excellent physical condition has a blood pressure of 180/100 which finally comes down to 154/90 when he has a chance to relax. A young man of 24 presents a blood pressure 174/90 which later reaches a basal level of 138/84. What should be done with these candidates? According to the naval standards we cannot accept the first man since his systolic blood pressure has persisted above 150, but we may accept the younger man because his blood pressure finally dropped below 140.

There are many factors to be considered in blood pressure readings. It is appreciated that excitement elevates arterial tension and that is why the Manual prescribes reexamination. On the other hand, it has become quite clear now that a patient possessing a definite hypertension may at times present a normal blood pressure reading (1) (2) (3) (4) (5) (6). In fact, the blood pressure of hypertensives is notoriously labile. Both clinicians and insurance companies now know that if the blood pressure rises to abnormal heights it may be actual hypertension, pre-hypertension, or potential hypertension. While the Navy will accept the candidate whose blood pressure finally comes to resting levels, the insurance companies are reversing themselves and are wary of high figures even if transient, for their statistics show that these persons tend to become permanent hypertensives in later years (7) (8).

The writer recently called back for reexamination 50 hospital patients 40 years of age and over because in their hospital stay, during routine examinations, only one blood pressure had been recorded. These had been borderline readings, but since a hospital naturally places the patient under emotional and mental stress, hardly anyone would consider the following as very significant: 152/80, 158/90, 150/80, 150/77, 150/85, 150/86, 150/94, 152/90, 154/90, 152/88, 150/90, etc. Yet on thorough reexamination (1 to 7 years later) and with many

blood pressure readings on each patient, 76 percent were found to present a definite hypertension, usually much higher than the single initial reading and about one-third disclosed diastolic blood pressures over 100 (respectively, 125/80, 160/90, 150/95, 128/90, 150/95, 185/105, 168/95, 158/105, 145/82, 158/108, 170/105, etc.)

We cannot afford to turn away the borderline or mild hypertension applicant in wartime. We all know that this man will be good for even most strenuous physical activity for years before definite hypertension appears or becomes a fact. However, if the Navy accepts this candidate and if his blood pressure increases because of the natural course of the hypertension, the finding of a definitely elevated blood pressure after the man has been in service can, by present laws, be construed as caused by or aggravated by service in the Navy. In the case of an officer he will be surveyed out with three-quarters of his regular pay for the rest of his life.

The purpose of writing this short article is to show that hypertension is common, particularly over the age of 40. If it is as common as we believe it to be, a moderate hypertension cannot be considered abnormal and we should accept the type, pre-hypertensive or potential hypertensive that we have described, with a waiver, provided a law is passed by Congress proscribing any disability or retirement claim based on such hypertension.

Our material now consists of 15,000 cases from industry, a large general hospital in which admissions for hypertension have been minimal, and homes for the aged (not sick). Elsewhere we expect to give in detail our reasons for believing these cases a proper sample of the population as a whole in regard to blood pressure. Preliminary reports on smaller groups have already been published (9) (10).

With the help of Mr. H. H. Marks of the Statistical Bureau of the Metropolitan Life Insurance Co., we have compiled this table:

Hypertension by age

MEN

Age	140/90	150/90	150/95	150/100
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
40 to 49.....	33.6	25.9	16.9	15.4
50 to 59.....	49.2	40.6	32.8	31.7
60 to 69.....	66.5	56.3	51.0	50.4

WOMEN

40 to 49.....	39.2	32.0	23.6	22.7
50 to 59.....	64.6	53.4	46.6	45.5
60 to 69.....	77.9	67.7	64.5	64.0

In other words, on the basis of 140 mm. or over systolic and/or 90 mm. or over diastolic, just about one-third of the men between 40

and 49 years of age have hypertension, approximately one-half between 50 and 59, and two-thirds in the seventh decade. Women have considerably higher figures and this may be particularly significant if they are accepted into the Navy in large numbers.

Considering 150 and/or 90 or over, a little over one-fourth the men 40 to 49 have hypertension; a little over two-fifths, 50 to 59; and considerably more than half, 60 to 69. Women again, have considerably higher figures.

Actually, the percentages are higher than given in this table if one considers the incidence in those 40 years of age and over, 50 years of age and over, and 60 years of age and over, since the incidence of hypertension rises with age. We expect to obtain these figures taking into consideration the actual population by decades in this country in 1940. It can be stated, meanwhile, subject to complete analysis of our data by the Statistical Bureau of the Metropolitan Life Insurance Co. that for all men 40 years of age and over, the incidence of blood pressure 140 plus and/or 90 plus is 50 percent; 50 years and over, 60 percent; 60 years and over, 70.5 percent and for women the respective figures are 60 percent, 72.5 percent, and 80 percent. For blood pressure limits of 150 plus and/or 90 plus for 40 years of age and over, 41 percent; 50 years of age and over, 50 percent; 60 years and over, 60 percent; and for women 51 percent, 62 percent, and 70 percent, respectively.

No conclusion is drawn as to the relative merits of a blood pressure of 110/80 and 140/86 in a boy of 20 for example, or a blood pressure of 134/90 and 160/100 in a man of 50. The Navy would still exercise the right, during peace and war, to set its own limits. That the Navy is wise to be strict in peacetime can be confirmed by the fact that during a recent special examination of naval officers between 58 and 64 the incidence of so-called borderline hypertension or actual hypertension was considerably less than in the general population.

SUMMARY

Hypertension is so common that it is probable that blood pressure limits of 140 and/or 90, 150 and/or 90, 150 and/or 95, 150 and/or 100 cannot be considered abnormal after the age of 40.

Under the age of 40, borderline blood pressure levels or actual hypertension levels of slight or even moderate degree for the age, whether obtained under stress or not, probably indicate a subsequent hypertension even if normal readings are finally obtained before acceptance in the Navy.

It is suggested that candidates whose blood pressures are of the type described be accepted in both the Regular Navy and the Reserve under waiver provided a law is passed by Congress that no compensa-

tion or pension be paid to such a person because of the appearance of a definite hypertension or an increase in blood pressure during his service in the Navy, for the duration of this war or any emergency as designated by the Navy Department. It is advisable that Congress do this immediately so that the Navy obtain an adequate number of desirable men and to spare the government hundreds of millions of dollars in pensions for a condition which becomes apparent or progressive with age and which is not due to war service.

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POSTOPERATIVE ILEUS¹

By GURN STOUT, Lieutenant Commander, Medical Corps, United States Naval Reserve

Ileus may be defined as a pathologic syndrome characterized by disorganization and impairment of the motor function of the gastrointestinal tract, sometimes resulting in complete cessation of motor activity with consequent functional obstruction, and blood chemistry changes peculiar thereto (1).

For some time I have felt that the term ileus should be used in a restricted sense in order to avoid a confusion in terminology. I have

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excluded all frank cases of mechanical obstruction of the bowel, and included only the functional or so-called paralytic type of obstruction in the term ileus. I believe this to be a wise step.

ETIOLOGY

The mechanism involved in the production of ileus is not well understood. The syndrome ileus appears to be initiated by a nervous system reflex which produces a state of atony of the gastro-intestinal musculature. This initial intestinal atony is followed by other abnormal changes and conditions which result in the complete syndrome. The autonomic nervous system is divided into two groups of nerves: First, the sympathetic, and second, the parasympathetic. These two groups, in the normal person, seem to be in a state of balance. When there is an imbalance, various symptoms arise.

Some persons seem to be more susceptible to direct and indirect stimulation of the splanchnic nerves of the sympathetic nervous system. We know that electrical stimulation of splanchnic nerves results in inhibition of peristalsis and decrease in intestinal tone while, at the same time, the musculature of the sphincters is stimulated and they become tightly closed.

In ileus there seems to be an imbalance on the sympathetic side. In other words, a preponderant sympathetic activity or sympathotonic state exists.

OCCURRENCE

The condition of impaired motor activity of functional obstruction of the gastro-intestinal tract that we call ileus frequently occurs in otherwise normal postoperative patients. Ileus is probably the most frequent postoperative complication with which abdominal surgeons have to contend.

Ileus is essentially a complication. It does not occur separately from, or unprovoked by, some traumatism or pathologic condition. The most common precursor is peritoneal traumatism or irritation. Ileus sometimes occurs following painful injuries and conditions such as fractures, renal colic, biliary colic, and torsion of pedunculated ovarian tumors. Its development is well known in typhoid fever, pneumonia, and gastro-enteritis. Inflammations of the intestines whether of the peritoneum or mucosa predispose to the condition.

In diffuse peritonitis ileus is practically always a complicating factor. Unless the virulence of the infection is so devastating as to cause the patient's death within 7 or 10 days, ileus is an equal, if not greater, contributor to the fatal issue. Ileus is a complication of all neglected cases of intestinal obstruction. The bowel proximal to the closure is in a state of paresis for a varying distance. We thus have two obstruc-

tions: First, the mechanical (intestinal obstruction) and, second, the functional (ileus). Restoration of patency relieves only the former. The remaining functional (paralytic) obstruction, the ileus, cannot be ignored without adversely affecting the surgeon's mortality rate.

PATHOLOGIC PHYSIOLOGY

There is present in ileus an overactivity of the sympathetic nervous system. This is probably the first abnormality manifested. It causes an inhibition of peristaltic activity and a loss of tone of the gastro-intestinal tract.

The depressed peristaltic function and loss of tone hinders expulsion of the gases which have accumulated because of swallowed air, fermentation, and diffusion of gases into the bowel lumen from the blood stream. It is characteristics of gases that they completely fill any space within which they are confined. So, as the intestines lose tone and become flaccid and distensible they are expanded by the gases within them.

These conditions interfere with the absorption of water. This important clinical observation was brought to attention in a paper published in 1933 (2). Approximately 50 percent of the intestinal distention present in ileus is due to unabsorbed water. My only explanation for this is that the stretching and thinning of the villi interferes with their function, perhaps by impairing the blood circulation in these structures. Therefore, if the patient is given excessive water his distention is aggravated. The digestive secretions amount to 7 to 9 liters daily. If the patient with ileus is given food, these secretions are poured into the gastro-intestinal tract and are not fully reabsorbed, thus producing additional distention.

As a result of these various pathologic changes the motor function of the gastro-intestinal tract becomes completely disorganized. Efficient propulsive activity in the normal direction is lost. Reverse peristalsis occurs early in these cases. In advanced stages of the disease all motor function ceases although a true paralysis never occurs.

The metabolic changes of chief importance are:

1. Dehydration.
2. Hypochloremia.
3. Decrease in blood plasma.
4. Disturbance of acid-base equilibrium.

The anhydremia is due to emesis and deficient absorption of water. Water accumulated in the gastro-intestinal tract is of no value to the patient. It is a detriment in that it increases distention. Electrolyte depletion results, of course, from vomiting. Experimental work on dogs by Gendel and Fine (3), and by Fine, Hurwitz, and Mark (4) on humans, showed that acute intestinal obstruction caused a reduc-

tion of plasma volume and proved that the decrease in plasma volume was due to the intestinal distention. Fine, Fuchs, and Gendel (5) proved that decompression of the bowel stopped loss of plasma volume. The work of Mecray, Barden, Ravdin, and Frazier (6) (7) (8) indicates that hypoproteinemia decreases gastro-intestinal motility.

SYMPTOMATOLOGY

The course which ileus follows is variable. In some cases it develops with rapidity, quickly reaching a point of complete functional obstruction. In the vast majority of cases, however, the course is one of slow and insidious progress. Improvement is at times manifested only to be followed by discouraging setbacks, with death following gradual exhaustion of the patient's strength.

In presenting the symptomatology of this syndrome it is my purpose to emphasize in every possible way the personal opinion that ileus should be considered a distinct clinical entity. It is felt that this will tend to make surgeons ileus conscious, and serve to lay a firm foundation for more efficient diagnosis and more logical treatment. With this thought in mind the symptoms are presented in four arbitrary stages.

First stage.—The patient may call attention to any or all of the following: Nausea, gas pains, belching, hiccupping, palpitation, abdominal discomfort of a generalized nature, an excessive expulsion of flatus. The surgeon may observe abdominal fullness, anorexia, a complaining mental attitude, and frequent borborygmi on auscultation. This is a common picture of incipient or early ileus. At this time response to proper treatment should be immediate.

Second stage.—The patient continues to mention nausea, abdominal discomfort, and excessive flatus. Gas pains have usually disappeared. Abdominal distention is slight or moderate and borborygmi are still heard. The patient vomits a watery, golden or green liquid. The patient's tongue is dry; his rest and sleep are much disturbed, and his mental attitude is one of anxiety or apprehension.

Third stage.—The patient remarks less about his nausea and abdominal distress. This is probably due to a blunting of the sensibilities. Tympanites is prominent but borborygmi are heard less often. Flatus is expelled in only moderate or slight quantities. The patient complains of thirst even with an adequate oral intake of water. Gastric retention is present in spite of frequent vomiting. The emesis has a green, yellow-brown or, occasionally, blue color. Restlessness, sleeplessness, dehydration, and oliguria are now readily apparent. The patient "looks sick" and his mental reaction is one of resignation or fatalism. He realizes that he is seriously ill. A roentgenogram of the abdomen shows the intestines well outlined. Examination of the emesis may give a positive reaction for indole or skatole.

Fourth stage.—Nausea and abdominal distress are seldom mentioned by the patient. Borborygmi are usually not heard and there is little or no flatus expelled. Still present are tympanites, gastric retention, dehydration, oliguria and vomiting of liquid which is now brown, or occasionally black in color, and having a definite fecal odor. Occasionally the vomitus is a dark reddish-brown due to decomposed blood resulting from diapedesis from the mucous membranes.

A roentgenogram of the abdomen presents the typical stepladder effect. The patient looks toxic, is often cyanotic and one sometimes observes subsultus tendinum and the facies hippocratica.

The mental status follows one of two courses: The depressive, in which there appears lethargy, clouding of consciousness, stupor and coma; or the excitatory course, in which one observes successively a sense of well being, unusual alertness, irrationality, irritability, excitation, and sometimes mania.

COMPLICATIONS

The surgeon should not permit a condition of ileus to obtain day after day, even though the patient's life does not seem to be in jeopardy. I say this not because the patient is miserable and will not thank him for it, but for another reason. My personal experience and a survey of charts convinces me that failure to subdue the ileus promptly results in certain additional hazards:

1. Intestinal obstruction.
2. Evisceration.
3. Peritonitis through failure of anastomoses or caused by infected wounds which have to be resutured.
4. Pulmonary hypostatic congestion and bronchial pneumonia.
5. Peripheral circulatory failure.

The intestines often reach such size that, lacking sufficient space, the loops become sharply angulated. There is then a superimposed partial mechanical obstruction. In cases presenting peritoneal inflammation these angulations become definitely fixed due to adherence of peritoneal surfaces that have been pressed firmly together. Even in the absence of inflammation this added difficulty may arise from the visceral peritoneum adhering to the raw surface of the parietal side of the abdominal incision.

Experimental work by Clark (9) and by Harvey and Howes (10) in 1930 shows the importance of an adequate protein diet in wound healing. Eviscerations are common in postoperative patients who have suffered from ileus for 8 or 10 days. This unfortunate complication is the result of numerous factors, all present in ileus which include hypoproteinemia (11) and vitamin C deficiency (12) plus the disrupting effect of coughing, hiccoughing, belching, and vomiting when the abdomen is distended.

Edema, both pulmonary and general, is probably a consequence of the drop in plasma protein (13) (14) (15). As plasma protein is reduced the blood stream loses water through the capillaries. This probably happens in the lungs allowing a transudate to collect in the acini. Infection finds a fertile site in such a respiratory tract.

These pulmonary complications are rendered more likely by a reduced vital capacity. As emphasized by Overholt (16), the laparo-

tomy patient has an intra-abdominal pressure greater than normal which pushes the diaphragm upward. The decrease in plasma volume which permits passage of water and electrolytes through the capillaries plus dehydration causes a reduction of total blood volume. This and vasodilatation produces peripheral circulatory collapse and death.

DIAGNOSIS

Most cases of ileus follow abdominal surgery and so the diagnosis will be considered from that viewpoint. An anesthetic may cause nausea and vomiting during the first 4 hours after completion of an operation. Nausea and vomiting occurring later than 4 hours must be viewed with suspicion and when it occurs later than 8 hours it should always be considered as due to beginning ileus until proved otherwise. This is a practical though arbitrary rule of thumb.

Following an elective operation, with good anesthesia and surgical technic, the convalescence should be unmarked by nausea, emesis, gas pains, abdominal distention, or distress. Such symptoms indicate an abnormal postoperative course. The normal postoperative period is remarkably free of discomfort except for some pain in the immediate region of the incision.

The diagnosis is established by the development of symptoms as outlined under the heading symptomatology. If the syndrome ileus is kept in mind the diagnosis is readily made from the history and physical findings.

There is one point which must be kept in mind regarding abdominal distention. The abdomen may be soft and flabby when the intestines are tremendously dilated. This is due to a difference in development of the abdominal muscles. This situation is best exemplified in the multiparous woman, particularly if recently pregnant. The contrary is also true. It is possible to have intestinal distention with a flat abdominal wall. This may be the case in the muscular person, athlete or manual laborer. Failure to realize this is a diagnostic pitfall for many.

DIFFERENTIAL DIAGNOSIS

The chief condition which is apt to confuse the diagnosis is secondary bowel obstruction. Laboratory aids are no help. On a flat roentgenogram of the abdomen one occasionally sees a definite point of obstruction, there being distended loops of intestine which abruptly give way to collapsed segments. More often the roentgenologist can only determine that an intestinal obstruction exists without being able to say whether it is functional or organic in character. One can usually make the differential diagnosis from a careful study of the

history and physical examination. With ileus the patient usually presents symptoms of the syndrome within 24 hours of operation. These symptoms become aggravated and additional ones develop gradually and insidiously. With obstruction, the symptoms more commonly begin later in the postoperative period and more quickly develop. With ileus, the patient seldom complains of abdominal pain, but frequently of discomfort. With obstruction, pain due to colic is pronounced. On abdominal auscultation in the presence of ileus, peristaltic activity, if heard at all, is subdued in character. It is like the soft murmuring of a brook. With obstruction one hears sudden, abrupt peristaltic rushes which have a tinkling, metallic sound. The patient may simultaneously evince pain. Partial obstructions in the postoperative patient are of course more difficult than the complete ones to differentiate from ileus. In these cases of partial obstruction, if in doubt, the diagnosis should be ileus until proved otherwise. Ileus always responds to efficient treatment without operative interference. Failure to do so is strongly indicative of obstruction.

Ileus is frequently coexistent with other pathologic entities which often are the causative factors in the production of the ileus. One is many times confronted with the problem of determining whether ileus exists along with peritonitis. One should not omit percussing the abdominal flanks. Dullness here points toward peritonitis. With peritonitis, tenderness to palpation is practically always present and some degree, at least, of muscle defense, though not always. Peritonitis is frequently found with a soft abdomen.

Leukocytosis is always present in peritonitis except in overwhelming infections. There may be leukocytosis in ileus though rarely over 15,000. The differential count may show a shift to the left in either condition. The sedimentation rate is also increased in both cases. The Weltmann serum coagulation reaction may aid the differential diagnosis (17) (18) (19). A "shift to the left" occurs with this test in peritonitis but does not in simple ileus. In peritonitis the presence of exudate may sometimes be demonstrated by the roentgenogram.

Pulmonary edema or hypostatic congestion due to ileus is sometimes mistaken for pneumonia with a complicating ileus.

PROGNOSIS

Ileus uncomplicated by other pathology such as obstruction or peritonitis should almost never result fatally. Complete recovery, even in severe cases, can be obtained within a week by efficient treatment. The majority of well-developed cases will require from three to 5 days for recovery.

When ileus is permitted to develop fully through improper postoperative care and is not efficiently treated, recovery *may* occur, which indeed it usually does, but only after a stormy and most disagreeable time. Such cases often prolong hospitalization. In any event they cause the patient to reflect dubiously upon the excellent reputation of modern surgery.

All too frequently ileus results in death, not directly perhaps, but by the induced complications listed on page 60.

PROPHYLAXIS

Patients should not be purged preoperatively. Alvarez (20) (21) has shown that catharsis is followed by a refractory period during which peristalsis is inhibited.

Operations involving the peritoneum are likewise followed by a refractory period during which intestinal motor activity is depressed and tonicity lost. To restore tone to the gastro-intestinal tract as quickly as possible, parasympathetic stimulants are useful. Prostigmine methylsulfate 0.5 mg. and thiamine hydrochloride 1 mg. given together hypodermically every 4 hours for 10 or more doses postoperatively has seemed to me worthwhile. (Physostigmine sulfate 2 mg. is a good substitute for prostigmine and less costly).

During this refractory period there is, I believe, also an impaired absorptive capacity for water. For this reason it is wise to exercise a definite control over the liquids permitted orally and to increase the daily quota step-ladder fashion. It is suggested that following formidable abdominal surgical procedures the daily allotment beginning with the operative day should be somewhat as follows: 250 cc., 500 cc., 750 cc., 1 liter, 1.5 liters, 2 liters. For the simple abdominal operations the quotas might be on this order: 250 cc., 750 cc., 1.5 liters, 2 liters. These liquids may in part be liquid nourishment starting on the first postoperative day. They should be largely protein because it is not so fermentable as carbohydrate and, also, because protein is essential to proper wound healing. To cover the water deficiency during this time parenteral injections should be given. Proctoclysis and the Harris flush tend to cause reverse peristalsis and are inadequate.

Food stimulates the flow of digestive secretions, which may amount to 7 to 9 liters per day. If this water is not absorbed with normal rapidity, distention will result. For this reason solid food is best withheld until the patient has shown ability to drink at least one-half liter of liquid daily without evidence of nausea, vomiting or abdominal distention. This usually means the second or third postoperative day. Here again protein foods should be given priority.

TREATMENT

Once ileus develops, all food should be withdrawn and water orally restricted to 500 cc. daily. The additional estimated water required should be administered by injection of suitable solutions intravenously or subcutaneously such as Ringer's solution and 5 percent glucose. An amino-acid mixture suitable for intravenous use will probably be available by the time this paper is published (22) (23) (24).

Most important is the prompt institution of gastro-intestinal tract decompression. This is effected by passing a weighted, catheter-tipped duodenal tube transnasally to the duodenum or lower. This tube must be connected to an efficient negative pressure (suction siphonage) apparatus which should be used continuously. I have utilized continuous negative pressure on the inlying duodenal tube for gastro-intestinal decompression with most gratifying results since 1927. Before passing the tube, the nose and throat should be sprayed with an anesthetic such as 1 percent pontocaine, or 0.5 percent cocaine (alkaloid) in oil, and an abdominal binder put on the patient. This greatly helps prevent gagging and retching and lessens strain on the abdominal incision. Failure to take such precaution has resulted, on occasion, in evisceration. These duodenal tubes may be in place for considerable periods of time and it is well to lubricate them thoroughly with such an ointment as that shown in table 1. It also adds to the patient's comfort to instill a few drops of a flavored and scented mineral oil into the nostrils once or twice a day.

TABLE 1

	Gm. or cc.
Cocaine (alkaloid)	0. 3
Oxyquinoline sulfate .....	. 06
Pulvis caroid .....	. 3
Petrolatum	30. 0

In my opinion the operation of enterostomy is not necessary for decompression purposes. The method mentioned gives better results and is without the inherent disadvantages of the operation. Technically it is not an easy matter to perform an enterostomy when the intestines are dilated and thin walled. One should not subject one's already acutely ill patient to the shock of this procedure with the additional attendant risks of peritoneal and wound infection and an uncontrollable fistula. I repeat, that with suction siphonage one can decompress the gastro-intestinal tract far more effectively than with operation. Enterostomy for this purpose is now obsolete.

The use of an indwelling duodenal tube with siphonage induced by a syringe was recommended in the treatment of ileus occurring postoperatively in the year 1919 by Bassler (25), and by Matas (26)

in 1924. The credit for first using continuous negative pressure for more effective drainage belongs to Ward (27) (28) whose first paper appeared in 1925. Wangenstein (29) has done much to popularize the method.

The essential chemicals lost in the gastro-intestinal drainage must be made good. To accomplish this, 45 cc. of the formula shown in table 2 is given through the duodenal tube every 2 hours. At these times the suction is discontinued for 15 minutes. For each liter of drainage over 1, the ingredients not marked by an asterisk are doubled in amount.

TABLE 2

	Gm. or cc.
Sodium chloride.....	6.0
Sodium bromide.....	4.0
Sodium bicarbonate.....	5.0
Potassium chloride.....	.4
Calcium chloride.....	.5
Bile salts.....	2.5
Ascorbic acid.....	.1
Thiamine hydrochloride.....	.002
Casein hydrolysate (Amigen)*.....	60.0
Caroid*.....	4.0
Water.....	500.0

The rationale for some of these substances deserves an explanation. The purpose of the sodium bromide is to serve as a basic sedative. It is of interest, too, in that Haden and Orr (30) found that, next to sodium chloride, the bromide salt of sodium was most effective in prolonging the lives of dogs with intestinal obstruction. The caroid helps prevent plugging of the tube by digestion of albuminous substances. The casein hydrolysate, I have found, maintains a normal blood serum protein. Normal blood protein is essential to circulatory integrity and to insure wound healing.

If a biliary fistula is present, there is added to the formula of table 2, for each liter of bile drainage, sodium bicarbonate 5 gm., sodium chloride 3 gm. and bile salts 3 gm. For each liter of pancreatic juice lost through a fistula, the following is added to the formula of table 2: Sodium bicarbonate 6 gm., sodium chloride 3 gm., and pancreatin 3 gm.

As decompression is being obtained one should strive to improve the tone of the gastro-intestinal tract. The intestine will not function normally if flaccid, even though completely empty. Tone must be restored. The most popular drug to use for this purpose is pituitrin. I believe it to be too drastic and do not use it. It is impossible to eradicate a well developed case of ileus with a few injections of this or any other drug. No chemical agent can so stimulate a flaccid, atonic bowel that it will expel the long, tortuous column of liquid present in such a case. It is inadvisable to attempt to do so as it results in exhausting the contractile power of the intestinal musculature and sometimes causes unpleasant reactions.

After decompression is complete one gradually decreases the use of suction siphonage. Simultaneously liquid nourishment is begun and the total liquids given orally are gradually increased. If no reactions occur the duodenal tube may be removed.

When ileus is due to peritonitis, it is usually impossible to decompress completely the intestines as long as infection exists. The best that one is able to do is to keep the distention well under control. These cases often are protracted and it becomes necessary to administer more nourishment than can be given parenterally. Ordinary feeding is difficult in that the patient has no appetite, and such foods obstruct the duodenal tube. In such situations the formula given in table 3 is useful for tube feeding. It is a modification of one previously published (31). Fifteen cubic centimeters may be given every 2 hours to begin with and increased by a like amount each day as tolerated. It provides approximately 2 calories per cubic centimeter.

TABLE 3.—*Formula for tube feeding*

	<i>Gm. or cc.</i>
Sodium chloride.....	10
Glucose.....	25
Lactose.....	50
Dextrin.....	100
Arrowroot.....	75
Calcium caseinate (Casec).....	25
Amigen.....	50

Add water (distilled) to make thin paste, then add 500 cc. of water, and heat at 110° to 112° F. until dissolved. Then add the following:

	<i>Gm. or cc.</i>
Cod liver oil.....	15
Olive oil.....	15
Ascorbic acid.....	. 2
Cream 40 percent.....	100

Yolks of 2 eggs.
Yeast extract tablets (4).
Beef bouillon cubes (2).
Mix and beat until smooth.

The avoidance of upsets in chemistry, which may prove fatal, of dehydration and its converse hydremic plethora, while at the same time maintaining adequate necessary gastro-intestinal drainage is a difficult problem for the inexperienced. Its mastery does, however, pay dividends in the form of a lower mortality rate, and results oftentimes in the survival of patients that appear hopelessly ill.

SUMMARY

Ileus is defined. Ileus is presented as a progressively developing pathologic syndrome.

The immediate causes of ileus are given and the pathologic physiology is summarized.

The symptomatology of ileus is presented in four arbitrary stages as an aid to diagnosis and a better understanding of the condition.

The additional hazards that confront the untreated or improperly treated ileus patient are enumerated.

The diagnosis, differential diagnosis and prognosis are discussed.

The fundamentals of treatment of ileus are outlined and the importance of efficient gastro-intestinal decompression by the use of continuous negative pressure applied to the inlying duodenal tube is emphasized.

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THE SUTURING OF CLEAN WOUNDS¹

By T. McKEAN DOWNS. Commander, Medical Corps, United States Naval Reserve

In spite of the acquired skill and experience of centuries, we find that wounds do not always heal kindly. Disruptions occur, incisional hernias are seen, accumulations of so-called serum develop and prevent normal healing, and unexpected wound infections occur. The causes of these complications are not always apparent.

In considering wounds, there are four definite factors to be thought of. These are:

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1. The suture material.
2. The technic of using it.
3. The wound.
4. The patient himself.

SUTURE MATERIAL

A wide variety of suture materials is used at present. Catgut, in various sizes, silk, cotton, stainless steel wire among others, are all used as buried sutures, and all are more or less satisfactory; but it must be admitted that the perfect suture material has not yet been devised. Catgut is irritant to the tissues, especially when chromicised, the other materials remain permanently as foreign bodies.

Kraissl, of Whipple's staff, has recently tried to show that an allergy to catgut can be developed; making subsequent operation on the same patient more likely to be followed by wound complications. But investigators at Johns Hopkins have combatted Kraissl's work on theoretical grounds, and they were not able to produce any allergy to catgut in experimental animals.

It seems to make little difference in practice what sort of suture material is used, provided the size be small. Good healing will occur with any of the suture materials mentioned, or various complications may occur with any.

In former days, when it was our practice to use catgut of number 2 size, or larger, in doubled strands, it was almost routine to see collections of serum form, followed eventually by the extrusion of the knots. As long ago as 1888 Kocher was so impressed by this irritant action of the heavy gut used in his day that he abandoned catgut altogether in favor of silk. Halsted in 1913 again warmly advocated the use of silk, and developed a special technic for its employment, involving principally the use of very small sizes, and the most meticulous care in the handling of the tissues. This silk technic has again been revived and forcefully advocated by Whipple of New York, who reports exceedingly good results with it. He has been followed by a considerable number of surgeons.

There is no doubt that good results are attained with Halsted's technic; but if the same small sizes and careful handling are employed, the results with catgut are equally good. For a number of years I have used nothing larger than number 0 catgut; and for a year I used number 00000 with perfect satisfaction. However, the results with this were not sufficiently outstanding to justify the extra time required to insert them, and I have reverted to size 0 or 00.

TECHNIC

The technic of using the suture material is very important. Sutures should not be drawn tight, and allowance should always be made for the swelling of the wound edges that will occur within a few hours.

The function of the suture should be borne in mind. Its only purpose is to hold the wound edges in contact until union can take place, after which it is no longer necessary. No suture can do more than maintain this contact. The important factor is the union of the edges of the newly formed tissue. Suturing the tissues differs fundamentally from sewing together inanimate fabrics, as for example two pieces of cloth. In this case, throughout its life, the junction of the two layers depends on the thread used. The thread must, therefore, be drawn so firmly as to hold the pieces tightly together, and to prevent chafing and friction.

If the sutures in living tissues are drawn tight, a blanched zone is formed about each one by pressure; and if the sutures are sufficiently near together and tight enough, the adjoining blanched zones will coalesce. Healing is delayed and infection favored, due to diminished blood supply. One occasionally sees the whole wound margin slough out, apparently from this cause. However, more commonly the suture cuts through sufficiently to relieve the tension.

Everyone knows that if skin sutures are too tightly drawn, they will cut and leave unsightly scars; but it is sometimes forgotten that buried sutures, though hidden will also cut and loosen.

I have little doubt that the early recurrence of hernia which is occasionally seen when the patient first gets out of bed, is due to this error of too tight suturing—an error that is frequently fallen into in the operation of herniorrhaphy.

Wound infection is also favored by tight suturing. In spite of careful sterilization of everything that comes in contact with the wound, even in many cases of the air itself, and in spite of careful adherence to the aseptic ritual, infections of clean wounds occur all too commonly.

Skin disinfection, though, is only relative and the blood itself even in healthy persons from time to time contains living bacteria. Our only defense against these organisms, though usually a wholly adequate defense, consists of the antiseptic substances brought in abundance by an unimpaired blood supply. If the local blood supply is impeded as a result of tight suturing, it is not necessary to look farther than to the surgeon himself for the cause of these unexpected infections, which are so annoying.

Another error in technic that is often made inadvertently, is improper tying of knots. We are repeatedly advised to study seamanship and to use sailor's knots; but the advice is not necessarily relevant, for the surgeon and the sailor use knots for different purposes. The seaman requires a knot that will hold securely under all circumstances, but which is at the same time easily and quickly cast loose when no longer needed. Our knots are never untied.

The advice is usually given to tie ligatures and sutures with the square knot, and to avoid the granny for the same reason that the sailor does. But the seaman does this, not so much because the granny slips or is unsafe, as because when it has once been jammed it cannot be untied but must be cut. This very quality of the granny led Halsted in 1913 to recommend it to surgeons. As a matter of fact, both of these knots will slip, especially when tied in a slippery material like silk; but both hold firmly under any strain to which they could possibly be subjected in surgery.

A fact not often realized about these two reliable knots is that the loops of which they are formed, when upset and rearranged form slip knots. This upsetting occurs very easily, and is sometimes difficult to avoid. The inadvertent tying of a slip knot in place of a firm one is another cause of occurrence of incisional hernia, or of early recurrence of inguinal hernia.

THE WOUND

The wound itself, if accidental, must be accepted as we find it; but if it is an intentional operative wound, every effort must be made to plan it so as to have the minimum of tension, and to avoid, if possible, cross cutting of muscles or tendinous structures, for tension in the wound has the same effect as too tight suturing.

Every wound is lined by a layer of devitalized tissue, for the cells of which the body is composed are so small and so closely aggregated that it is impossible to insinuate even the sharpest instrument into the tissues without injuring some of them. Before healing can take place, this devitalized layer must be removed—a rapid matter in the case of clean incised and purposive wounds. In the lacerated and contused wounds, where this layer is many times thicker, healing is often much delayed. It can be much accelerated by a thorough debridement, which converts these lacerations and contusions into clean, incised wounds. If it is then possible to close them without tension, or to relieve tension by posture or otherwise, it should be done. If not, they should be left open to granulate, or be closed by plastic procedures.

The body cells are also susceptible to injury by antiseptics applied to the wound. The best antiseptic substances, and the only harmless ones, are those supplied by the body itself in the wound secretions. If the patient is seen early enough after injury to be still in the stage of contamination, the wound should be mechanically sterilized by debridement. Antiseptic solutions may destroy some bacteria, but they also surely destroy tissue cells and delay healing. (It will be recalled that this discussion is limited to the treatment of presumably clean wounds and does not consider those already infected.) In case

of doubt, it is well to leave the wound open and to close it later by delayed primary suture if infection does not develop.

THE PATIENT

The patient himself is the final factor, and a most important one in wound healing. The greatest operative skill in the world is of no avail if the patient's general condition is not such as to favor healing. Normally, wounds unite; yet occasionally union does not take place, or disruption occurs, for no very obvious reason.

The suture material is not a factor, for even wounds sutured with wire may disrupt, as I have recently seen in two cases in the Pennsylvania Hospital. In one, a patient with ruptured gastric ulcer, the abdominal wound broke open completely on the tenth day, although it had been closed with Babcock's stainless steel wire in anticipation of such a calamity. The other case, a woman who had had a cholecystectomy, returned to the follow-up clinic at the end of 3 months with a large incisional hernia.

In these cases of disruption the wound edges show no effort at repair; the margins look nearly as fresh as on the day the incision was made. Catgut sutures typically do not cut through, but are completely absorbed, though nonabsorbable ones cut their way out. There is never evidence of infection.

This complication occurs most often in those of poor nutrition, the cachectic, and the gastro-intestinal cases; but may be seen at times in persons who appear perfectly healthy and well nourished. I have seen it after Cesarean section. This is the type of occurrence that Kraissl tried to explain as due to allergy.

There are, it seems to me, two main factors to be considered here—a reduction of the plasma proteins and avitaminosis C or a state of subclinical scurvy. The cachectic patients are malnourished and in a state of protein starvation with considerably or greatly reduced plasma protein levels.

Subclinical scurvy, or avitaminosis C is probably widely distributed in the population even among many who seem in good health; but it is particularly common among those with disorders of the gastro-intestinal tract. It is notorious that such persons tend to limit themselves to one-sided diets of a most inadequate kind, and usually exceedingly low in vitamins. This is to such an extent the rule that it is hardly necessary to have studies of vitamin C levels done on blood or urine in emergency cases.

I have for some time made it a rule to give ulcer patients large intravenous doses of cevitamic acid, pre- as well as post-operatively in the elective cases, not depending on oral intake of orange juice.

In addition, all gastro-intestinal cases and cachectic patients have blood protein determinations done, and the attempt is made to bring the blood proteins to or toward normal by infusions of plasma.

Although I have not followed these procedures very long, yet they seem rational, and I have had no cases of wound disruption since employing them. Formerly, this complication was not rare.

CONCLUSION

The particular suture material used is not important, provided it is of small caliber, and inserted without tension. The wound should be closed without tension, and proper knots tied. Devitalized or contaminated tissue should be removed by debridement, and chemical antiseptics kept from contact with the wound. In case of doubt as to sterility, delayed primary suture can be employed.

Every effort should be made to keep the plasma proteins at or near normal, and a large intake of cevitic acid should be assured the patient.

THE LATENT PERIOD AND DELAYED HEMORRHAGE FOLLOWING TRAUMATIC RUPTURE OF THE SPLEEN¹

By W. H. BUEERMANN, Lieutenant Commander, Medical Corps, United States
Naval Reserve

Rupture of the spleen, whether traumatic or spontaneous, the result of perforating wounds or of subcutaneous injury, is usually a dramatic surgical problem and becomes rapidly fatal unless immediate operation is performed. The diagnostic acumen and the tactical ability of the surgeon is, however, more often challenged by those cases of splenic injury in which the clinical course is more prolonged. This is due to the too frequently forgotten fact that there can be, and often is, a latent period—a period of “symptomatic silence” (Baudet)—between the time of the initial injury to the spleen and the later appearance of symptoms of internal hemorrhage. This “silent” period may last from a few hours to a few days and, rarely, for weeks; and may lull the patient and the surgeon alike into a false sense of security suddenly to be shattered by rapid collapse with internal hemorrhage, even though the patient may have been active and about his business in the belief that the primary injury to his upper abdomen was not of much significance. This, then, is a brief introductory word picture of the clinical phenomenon known as delayed rupture of the traumatized spleen.

¹ Received for publication July 3, 1942.

The recognition and successful treatment of two such major surgical problems within a 5-weeks' period at a United States naval hospital and the postmortem recognition of a third case 6 weeks later have focused our interest upon this problem as one of more than passing interest in military surgery during time of war.

CASE REPORTS

CASE I

History.—G. J. B., apprentice seaman, age 22 years, was admitted to the hospital about 5:30 p. m. on February 18, 1942, with a chief complaint of generalized abdominal pain. According to the patient's history, while at stool about 8 a. m. he noticed a sudden onset of pain in the abdomen which doubled him up and provoked nausea and vomiting. He felt faint, and developed successive attacks of syncope each time he tried to stand or walk. His "buddy" assisted him from the dock, where the acute onset had occurred, to the ship's sickbay where he was treated for shock until about 5:30 p. m. when his condition permitted transfer to the hospital. He was still complaining of severe pain in the abdomen, especially under the right costal border and in the right lower quadrant. He gave, in addition, a history of attacks of indigestion and occasional left upper quadrant jabs of pain which came at infrequent intervals. He stated that the morning excreta had appeared dark in color but with no signs of blood.

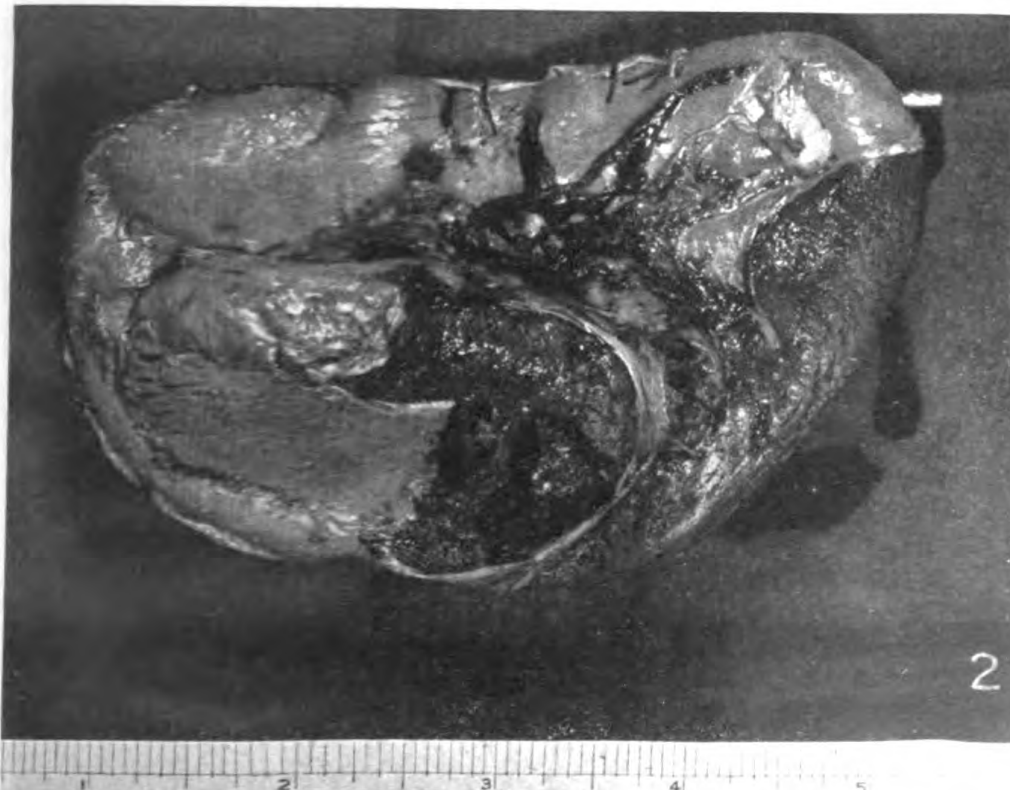
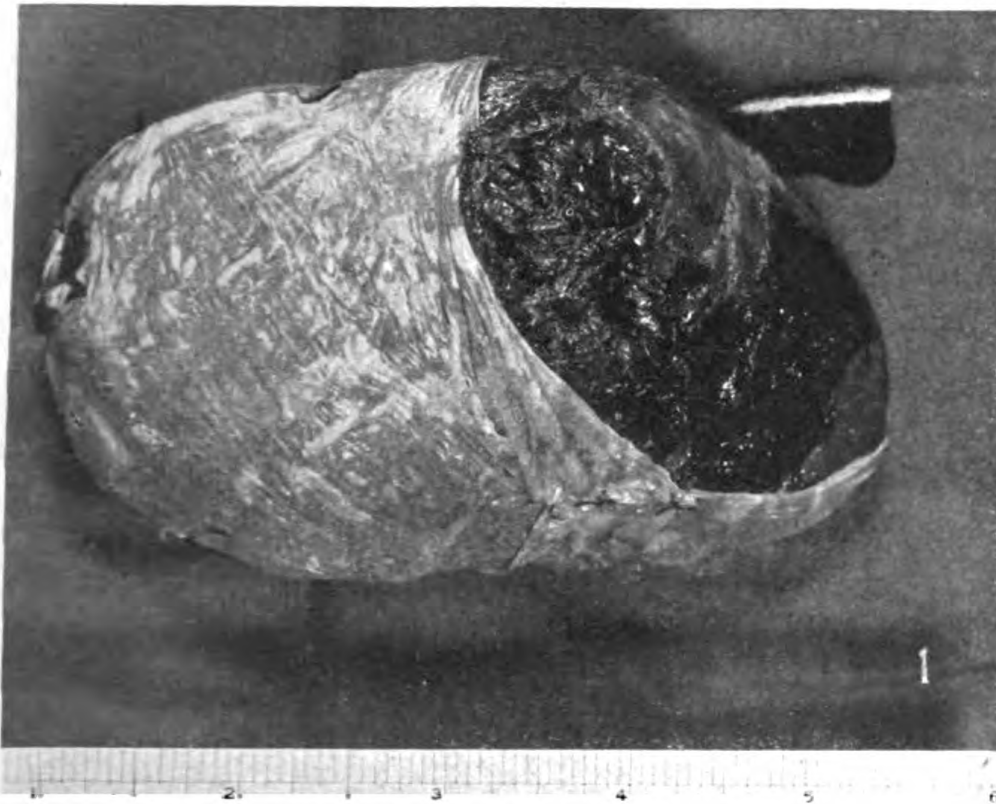
Approximately 1 week prior to the above described attack, while his ship was en route to this port, he had experienced a similar, but lighter attack, which caused upper abdominal pain of sudden onset but which subsided to a dull ache after about 24 hours with only a residual soreness remaining in the upper abdomen.

On January 11, at the time his ship was torpedoed, he had been thrown forward against a steering control mechanism, striking the left side of his chest and abdomen in the region of the spleen. He stated that he noticed residual soreness in the left side for about 1 week thereafter but lost no time from his work on board ship. He had been conscious, however, of soreness in the left side of the abdomen when closing steel file drawers, in the office where he was working, by pushing them shut with a short, snappy push with his abdomen against the drawer. This soreness had practically subsided when he developed his first attack, 1 week prior to the disabling attack. (This history was obtained during his convalescence.)

Physical examination.—Examination revealed a well developed, young, adult male, with slight anemic appearance, lying with knees partly flexed on his abdomen. The skin was cold and clammy to the touch and breathing was rapid and largely thoracic in type. The temperature was 99.4° F., pulse 126, respiration 36, and blood pressure systolic 102, diastolic 50. Examination of heart and lungs revealed no abnormal findings except the tachycardia.

Abdominal examination revealed no palpable masses. The entire abdomen was tender to palpation with a generalized abdominal rigidity more marked in the right half of the abdomen, and with the point of maximum tenderness in the right upper quadrant. Liver dullness was absent over the anterior portion of the liver, and rebound tenderness was most marked in the right subcostal area. (Blood pressure reading at 9 a. m. on board ship was systolic 60, diastolic 40.)

Laboratory findings.—Blood studies made at 9 a. m. showed erythrocytes 3,600,000; leukocytes 18,000, with 71 percent polys. At 5 p. m. there were: Erythrocytes 3,760,000; leukocytes 16,960, and 93 percent polys.



1. (CASE 1). SHOWING SUPERIOR-LATERAL SURFACE OF SPLEEN WITH INTRASPLENIC HEMATOMA AT SITE OF RUPTURE OF SUBCAPSULAR HEMATOMA —
2. (CASE 1). SHOWING SITE OF INTRASPLENIC HEMATOMA ON MEDIAL SURFACE ADJACENT TO VASCULAR PEDICLE.

X-ray examination.—An x-ray examination of the lower chest and abdomen revealed no evidence of free air in the abdominal cavity.

Diagnosis.—A tentative diagnosis of perforated peptic ulcer was made and immediate surgery advised.

Operative procedure.—Operation was started at 10:15 p. m. under drop-ether anesthesia.

A high, right paramedian, split-muscle incision was made. Upon opening the peritoneum a small amount of free blood was encountered. Exploration of the duodenum revealed a normal pyloric outlet and duodenum. The spleen was then explored and found to be buried in a mass of blood clot which, when separated from the splenic pedicle, gave evidence of active bleeding. Because of the technical difficulties to be encountered in performing a splenectomy through a right rectus incision in the presence of an active hemorrhage and a falling systolic pressure, the pedicle was digitally controlled while 300 cc. of pooled human plasma were given. The systolic pressure, as well as the patient's condition, showed marked improvement within 15 minutes and the operation was resumed. The spleen was separated from parietal wall adhesions and packed toward the mid-line, according to the method of Balfour (1). This made the splenic pedicle accessible to clamps. The pedicle was divided into three segments, the vessels clamped, cut and doubly ligated. The abdomen was closed in layers, and at the completion of the operation the blood pressure averaged about 155 systolic, with a diastolic of 85.

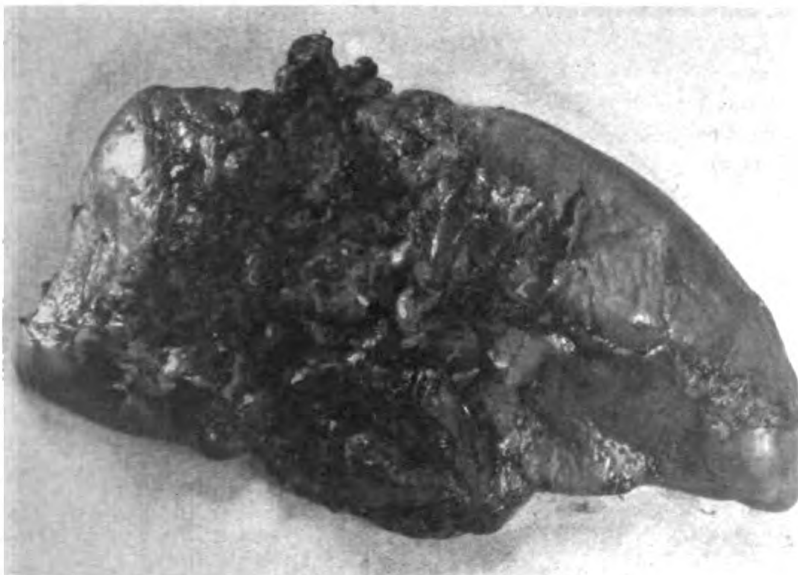
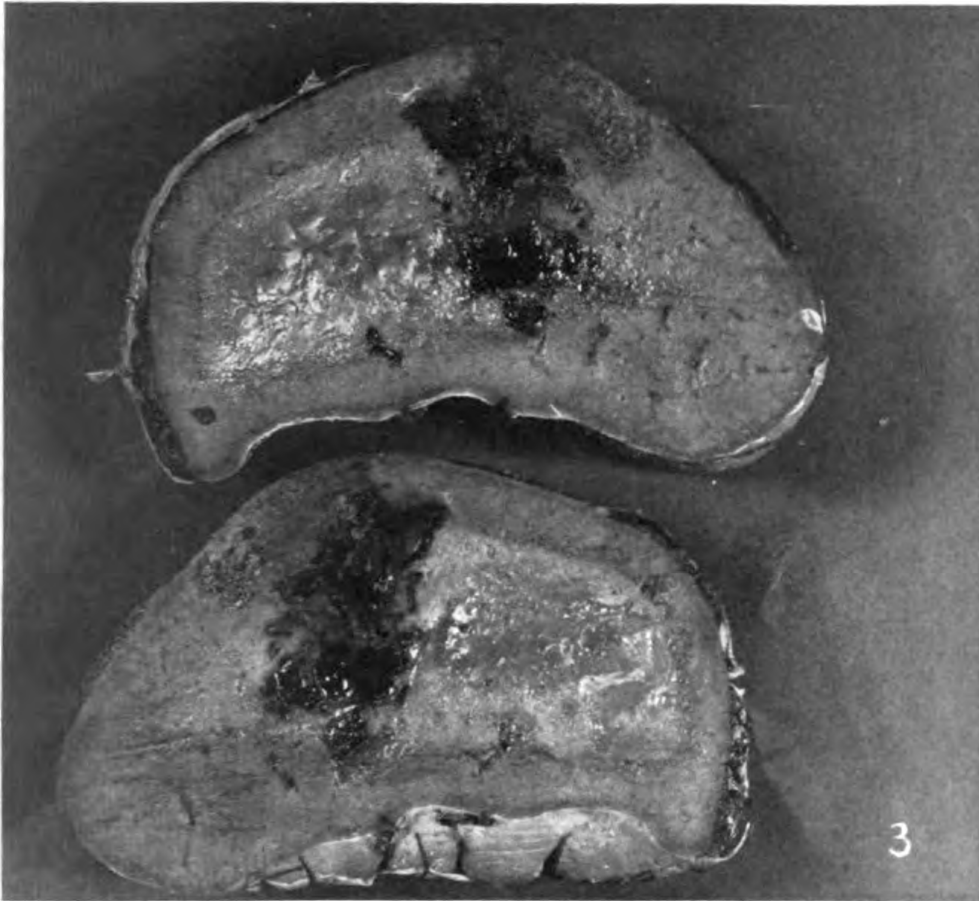
The following morning a blood transfusion of 500 cc. of citrated blood was given. Convalescence proceeded without event except for a slight skin separation which was corrected by adhesive coaptation. The patient returned to duty on March 27, 1942, with a hemoglobin reading of 91 percent, erythrocytes 4,600,000, and leukocytes 5,000.

Pathological report.—Gross examination: The spleen measured 12 x 7 x 7 cm. and weighed 195 gm. The capsule over the convex lateral surface revealed a linear tear 7 cm. in length. A mass of firm blood clot presented through the capsular rent. On section a narrow zone of subcapsular hemorrhage was seen. This covered the parenchyma of practically all the convex surface of the organ. Deep in the parenchyma there was an irregular blood clot 4 by 2.5 cm. which was in contact with a wedge-shaped peripheral infarction 2 cm. deep. The blood clot varied in color and consistency, the deeper portions being firm. The infarcted area was soft, light brown in color, and that portion directly beneath the capsular tear was friable. Microscopic: The capsule in the vicinity of the tear was thin and the cells of the connective tissue nuclei stained poorly. The cell protoplasm was neutrophilic. There was necrosis of the reticulum cells in the infarcted area and there were dissecting hemorrhages throughout. In the deeper portions the blood clot was laminated and there were areas in which organization had begun, as evidenced by the fibroblasts present.

Anatomic diagnosis.—Infarction of the convex surface of the spleen with dissecting hemorrhage, parenchymal and subcapsular; necrosis and rupture of the splenic capsule.

CASE II

History.—R. D. Q., seaman, second class, age 17 years, was admitted to the hospital on March 28, 1942, with a chief complaint of pain in the abdomen. He stated that on March 26, about 11 p. m., while running across the dock with his arms full of clothes, he stumbled and fell flat on his abdomen, striking the dock floor with considerable force. He lost consciousness for a few seconds, then was helped to his feet by two workmen, and walked about 100 yards to his ship. About 20 minutes later he was taken to the ship's sickbay because of



3. (CASE 1). SAGITTAL SECTION SHOWING PRESENCE OF ORIGINAL ORGANIZED CLOT DEEP IN SPLENIC PULP WITH SUBCAPSULAR INFARCT SITE OF SECONDARY HEMORRHAGE AND SUBCAPSULAR HEMATOMA.—4. (CASE 2), SHOWING EXPLOSIVE LACERATION OF SPLENIC PULP ON LATERAL-SUPERIOR SURFACE OF SPLEEN. ATTEMPT AT CLOT ORGANIZATION IS PRESENT ON THE TRAUMATIZED SURFACE.

the complaint of abdominal pain, and later was removed to an air station dispensary where he remained until transferred to this hospital about 5 p. m. on March 28, 1942. There had been no vomiting and the patient appeared to be in good general condition.

Physical examination.—Examination revealed a well developed, young, adult male, lying quietly in bed, with good color to his warm and moist skin. Examination of lungs and heart revealed no abnormal findings. The temperature was 100° F., pulse 100, respiration 24, and blood pressure systolic 150, diastolic 70.

Examination of the abdomen revealed a fullness in the left side with some rather marked tenderness in the right lower quadrant. Normal peristalsis was heard and no rigidity was encountered in any portion of the abdomen except that which might have been due to voluntary guarding of the abdominal muscles.

Clinical course.—The following afternoon about 2:30 p. m. he developed evidence of abdominal distention after taking fluids at noon. He complained of more pain in the right upper quadrant. There was no evidence of free fluid in the abdomen and there had been no nausea or vomiting. Nasal suction through a Levine tube was instituted and at 3:30 p. m. his abdominal distention improved and normal peristalsis was again heard. Because of the continuous complaint of abdominal pain, an x-ray was taken of the chest and abdomen, which was reported as negative. Clinical opinion at that time favored evidence of intra-abdominal injury, probably contusion of the liver and spleen with possible bleeding. No gross or microscopic blood was found in the urine.

About 8:30 a. m. on March 30, the clinical picture changed and the patient complained of more severe pain in the right lower quadrant than on the left side. The entire abdomen was rigid to palpation and there was definite evidence of shifting fluid dullness in the left midflank area, as well as on the entire right side. The patient complained of pain in the left cervical and shoulder areas, and in the left chest on breathing.

Pressure over the left upper quadrant gave rise to severe pain in the left midcervical region. This pain was repeated each time pressure was made over the splenic area.

Tentative diagnosis.—A tentative diagnosis of traumatic rupture of the spleen with delayed hemorrhage and perisplenic clot formation was made; and immediate surgery recommended.

Operative procedure.—Under drop-ether anesthesia, a left upper rectus incision was made. When the peritoneum was opened, free blood was encountered in moderate amount. Palpation of the spleen demonstrated a rupture through the central portion of the spleen above the hilus severing the continuity of the spleen into two sections, one of which constituted about two-thirds of the spleen mass. The spleen was freed from surrounding adhesions and removed by doubly ligating the pedicle in three sections. Exploration of the liver revealed no evidence of traumatism. The abdomen was closed in layers. Three hundred cc. of pooled human plasma were given during the operation together with 250 cc. of citrated blood.

Laboratory findings.—Examination of the blood on March 28 revealed a hemoglobin estimation of 91 percent, erythrocytes 4,500,000, leukocytes, 13,400, polys 77 percent, basophiles 7 percent, and lymphocytes 16 percent. On March 30, prior to surgery, the blood count dropped to hemoglobin 77 percent, erythrocytes 4,200,000, leukocytes 10,600, polys 82 percent, basophiles 7 percent, lymphocytes 11 percent. On discharge to duty on April 22, the blood count had returned to normal.

Pathological report.—Gross examination: The specimen was a spleen 15 x 10 x 4.5 cm., weighing 167 gm. The organ was made up of two large fragments; the larger 10 cm. long, the smaller 5 cm. long. In addition there were several small bits of parenchyma without capsule. The capsule was torn in two and there were masses of blood clot adhering to the fractured parenchymal surfaces. Sagittal sections revealed a darker area surrounding the fracture margins which suggested that there had been a large infarct or hemorrhage through which the fracture had occurred. Microscopic: Sections through the parenchyma and the blood clots at the torn surfaces revealed massive hemorrhage with small islands of parenchyma surrounded by masses of red cells and fibrin. A few small, round cells had infiltrated the portion of the clot in contact with the parenchymal tissue. No other evidence of organization was seen.

Anatomic diagnosis.—Fracture of the spleen, recent.

CASE III

History.—H. E., CPO, age 44 years, was admitted at 8 p. m., May 12, by stretcher with a chief complaint of fever, malaise, and diarrhea. His history on admission stated that his general health had been excellent until on the night of May 10 when he was awakened by a "night sweat," felt sick all over, and was troubled with a marked diarrhea. He had neither eaten nor drunk anything of an unusual nature, such as shell fish or sea food. His diarrhea was severe enough to require hourly attention. During the first 24 hours of the illness he had "shaking spells" and a feeling of having an increase in temperature. During the night of May 11 and the following morning he had several attacks of epistaxis. He stated that the present illness was similar to his condition during an attack of malaria many years ago in Bombay. He had noticed a gaseous condition of the abdomen together with tenderness since the time of onset. No history of injury was obtainable during the period preceding the attack of illness.

Physical examination.—Examination revealed a well developed male with warm, moist skin, presently having a chill with jaws chattering. Temperature 104°, pulse 128, and respiration 22. Blood pressure was—systolic 110, diastolic 90. Tongue showed marginal redness. Pupils reacted normally; there was no evidence of icterus.

Examination of the chest demonstrated occasional râles present with no areas of dullness or breath sound changes. Examination of the heart demonstrated a tachycardia but no other abnormal findings.

The abdomen was large, somewhat distended, more tender than normal but with no areas of localized rigidity or muscle spasm. The spleen was palpable but not grossly enlarged.

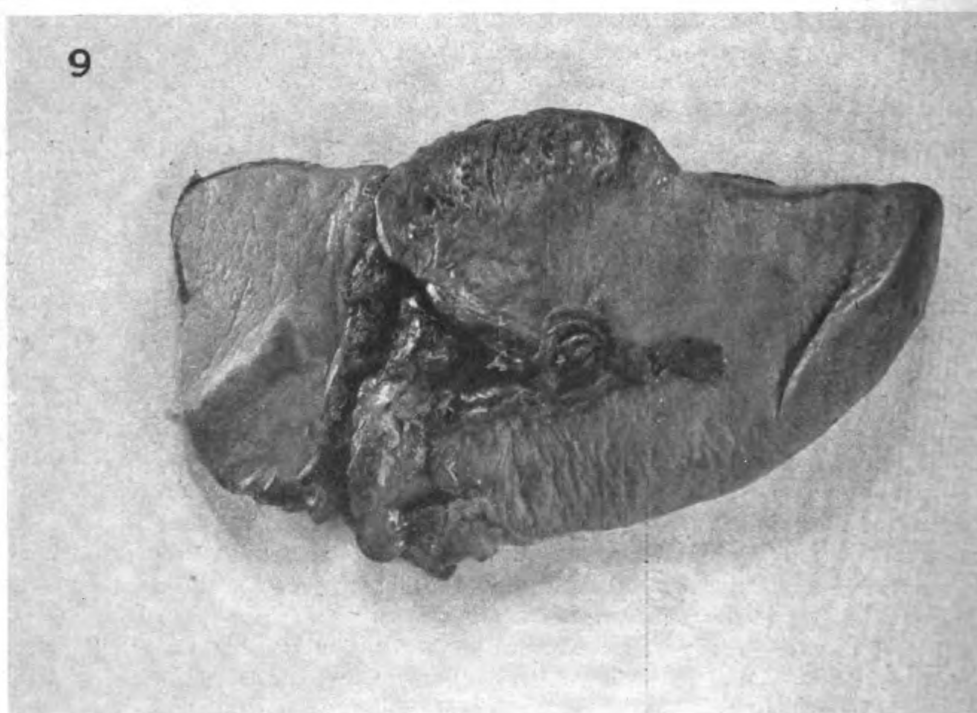
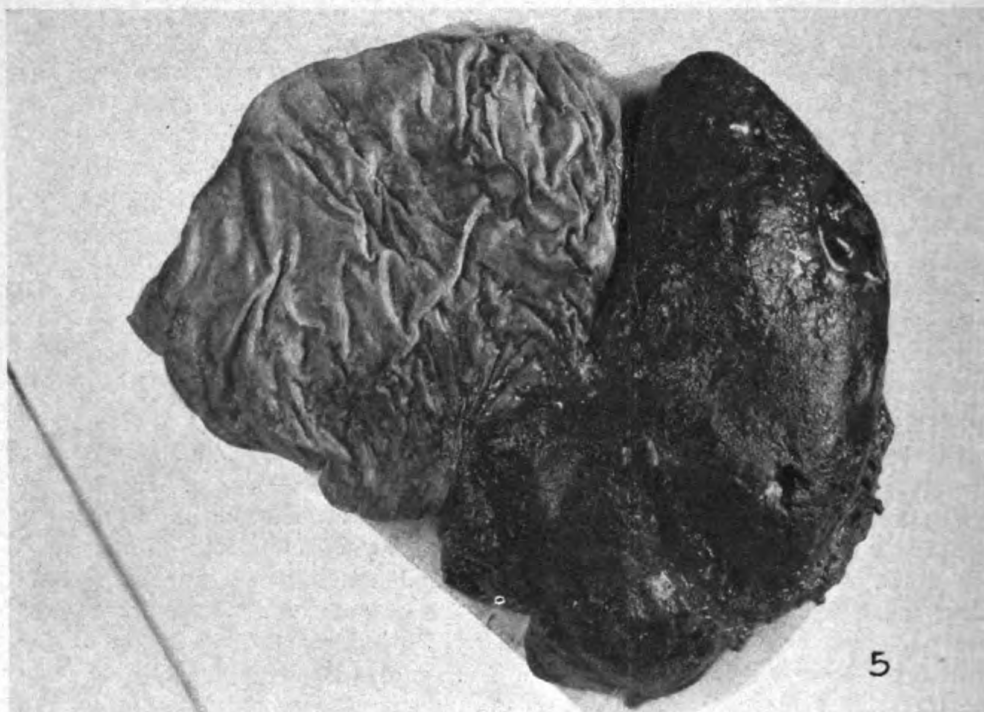
Genitalia were normal. Extremities revealed presence of ancient osteomyelitis of the left leg.

Laboratory findings.—Erythrocytes were 4,820,000, leukocytes 12,800, polymorphonuclears—segmented 63 and band cells 16, lymphocytes 15, and monocytes 1. Blood smears for plasmodia were negative.

Clinical course.—The patient was put to bed and given atabrin gr. 3, with a tentative diagnosis of malaria. At midnight he complained of insomnia, with an anxious restlessness. The pulse was thready and rapid, and the temperature was 104.4° F. He presented no complaint of specific pain and no symptoms referable to the abdomen. He developed, however, a productive cough during the 2 hours following midnight.

At 3 a. m. he was in considerable distress, suffering from air hunger and showing cyanosis, with a thin, thready pulse having a rate of 140. The blood pressure

PLATE 9



5. (CASE 2). MEDIAL SURFACE SHOWING THE ALMOST COMPLETE AVULSION OF THE SMALLER FRAGMENT ADJACENT TO THE VASCULAR PEDICLE.—6. (CASE 3). SHOWING CRESCENT-SHAPED ORGANIZED CLOT OVERLYING CAPSULE-DENUDED AREA OF SPLEEN ON CONVEX SURFACE.

was not determinable, and still there was no complaint of abdominal pain. The patient was then given 250 cc. of pooled plasma intravenously, and oxygen.

His respirations become progressively more labored with increased cyanosis, and, after a brief convulsive seizure, he expired at 4:35 a. m., May 13, 1942.

The medical officer on duty considered a tentative diagnosis of malaria on the basis of the past history and the findings of an enlarged spleen. The progressive increase in temperature with productive cough and respiratory difficulty suggested a beginning chest infection. The progressively developing symptoms then suggested a circulatory failure terminating in a circulatory collapse. The true diagnosis was suspected, when just prior to death, the spleen was not palpable although it had been previously. Because of the strictly medical aspects of the clinical syndrome, surgical consultation had not been obtained.

Autopsy findings.—The only positive findings recorded were as follows:

The right lung revealed a marginal area of consolidation which was dark red in color.

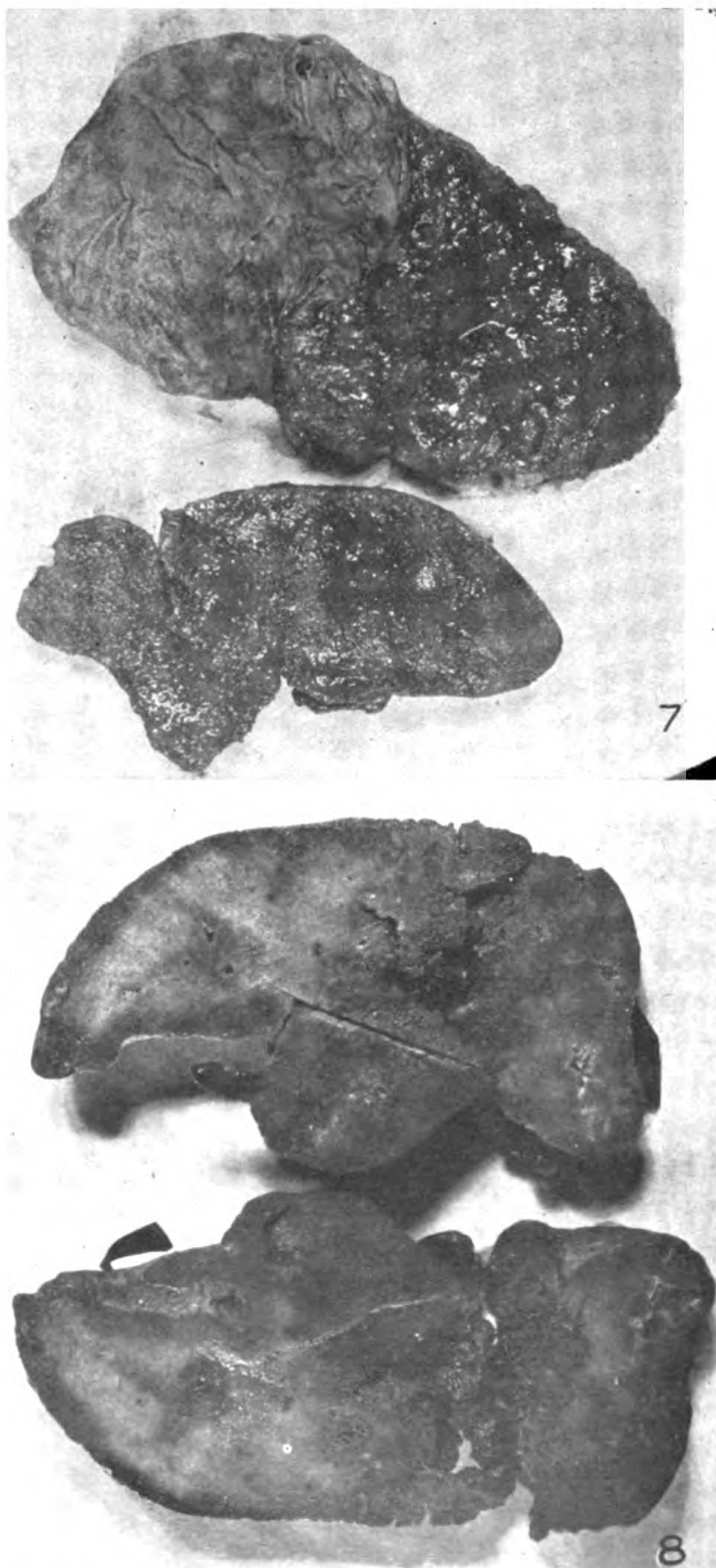
The abdomen, when opened, contained about 3 quarts of recently formed blood clots and fluid blood. The small intestine revealed small punctate and linear scars which were superficial and pale. The large intestine also revealed numerous punctate scars which were superficial and apparently ancient. The liver, gall-bladder, pancreas, kidneys, and adrenals were normal.

The spleen, when exposed, revealed a ruptured convex surface, with the superior half of the spleen covered with a flattened, partially organized blood clot 10.5 cm. long, 5 cm. wide, and 2.5 cm. thick. The clot was crescentic in shape. The spleen measured 13 x 7.5 x 2 cm. and weighed 127 gm. The organ was soft, friable, and dark red in color. The capsule was very thin. There was no gross evidence of infarction. Examination of the diaphragm and abdominal wall in the vicinity of the spleen failed to reveal any evidence of injury.

Anatomic diagnosis.—1. Rupture, nontraumatic, spleen. 2. Hemorrhage, intraperitoneal, severe, with exsanguination.

The progress of this case clinically suggests the possibility of a chronic splenitis dating from the time of his previous malarial, intestinal, and osteomyelitic infections. His occupation, that of inspector of construction, required that considerable climbing and stooping be associated with his activities. The autopsy findings of the spleen suggest an older hemorrhage with an adherent, partially organized, clot on the superior surface of the spleen, with the outer surface smooth and the splenic surface assuming the same granular surface contour as the capsuleless spleen surface against which it was lying. The rather severe abdominal complaint with distention suggested a mild hematogenous peritonitis with cul-de-sac irritation of the rectum and rectosigmoid.

Whether the additional slight trauma of examination of the spleen on admission together with the activity of transportation released the secondary terminal hemorrhage after a previous latent period will remain obscure; except that one may assume that there had been present a latent period between the initial hemorrhage and the subsequent secondary hemorrhage which caused rapid exsanguination and death before a definite diagnosis could be established.



7. (CASE 3). SHOWING CLOT REMOVED. NOTE THE GRANULAR APPEARANCE OF CLOT SURFACE CORRESPONDING WITH GRANULAR SURFACE OF DENUDED SPLENIC PULP.—8. (CASE 3). SAGITTAL SECTION SHOWING INTRASPLENIC HEMATOMA EXTENDING THROUGH ENTIRE DEPTH OF SPLEEN SUBSTANCE.

STRUCTURE OF THE SPLEEN

The spleen is the most friable of all abdominal visceral organs, superficially placed in the abdominal cavity, somewhat fixed under the ribs, with a tendency physiologically and pathologically to engorgement and enlargement. The fragile texture and thin capsule are additional reasons given for its liability to rupture when traumatized.

The structure of the spleen was studied by Robinson with the stereoscopic binocular microscope; and, from his investigations, he found the spleen pulp to be composed of a vast, delicate network of star-like cells with irregular protoplasmic processes running in all directions, uniting one cell with the other—these in turn forming attachments to the supporting framework. These he considered to be reticulo-endothelial cells, and the spleen itself may be viewed as a large reticulo-endothelial organ rather than as a lymph organ.

One of the physiological functions of the spleen is to act as a reservoir for blood, and for this reason engorgement of the spleen is present much of the time.

Barcroft (2) found from his observations that as man approached the equator there was a definite increase in the blood volume of the spleen. The spleen contains larger amounts of blood than suspected under normal conditions of living. This was demonstrated when dogs were given celluloid windows in their abdominal walls and under normal physiological conditions it was found that the spleen was larger than had been previously suspected, and larger than was later found under anesthesia and at postmortem examinations. It was estimated that during these periods of normal engorgement about one-sixth of the blood volume in dogs could be stored in the spleen.

Under abnormal physiological conditions the spleen underwent vigorous contraction during hemorrhage, narcosis, or muscular activity. These physiological variations in themselves may not have a direct bearing upon the spontaneous or traumatic rupture of the spleen. However, when associated with the varying degrees of intra-abdominal pressures, existing at the time of traumatic impact, as represented by the increased tension present during muscular contraction of the abdominal musculature and the decreased tension of a flaccid abdominal wall, an engorged spleen may be more likely to rupture. The state of contraction of the abdominal musculature at the time of traumatism has an indirect bearing on the protection afforded by the abdominal wall and lower left chest wall.

SPONTANEOUS RUPTURE

The apparently normal spleen is subject to spontaneous rupture under certain pathological conditions. The development of a spon-

taneous rupture in a normal spleen is still open to doubt, but that it can and does occur in the pathologic spleens of patients having previously suffered from malaria, typhoid, and certain infectious states has been established beyond question. Connors (9) reports the case of a male in normal health except for a three week's history of constipation and with no previous history of injury or illness, who developed a spontaneous rupture of his spleen. He reported in addition to his own case, 12 additional cases of spontaneous rupture of the spleen culled from the literature:

Five—In patients living in tropical countries.

Two—In apparently normal persons.

Two—After slight exertion in patients convalescing from sepsis.

One—Following severe exertion in a patient suffering from a paronychia.

Two—In patients with infections of a minor nature.

Fieber (10) reported a case of spontaneous rupture of the spleen in a patient convalescing from appendicitis.

PRIMARY TRAUMATIC RUPTURE OF THE SPLEEN

One of the most dramatic of all intra-abdominal injuries seen by the surgeon is that of splenic rupture due to direct or indirect injury. Approximately 500 such cases have been reported in the medical literature since the fifteenth century. Traumatic rupture of the spleen was considered a fatal injury up to the time of the eighteenth century. The first splenectomy performed in the United States was by Browne (7) in 1814, and the first splenectomy for ruptured spleen was performed by Riegner (18) in 1893.

McCracken (13) observed 20 cases of traumatic rupture of the spleen in China, all of the patients observed being between the ages of 10 to 39 years. Fifty percent of his cases were the result of assault and battery. One method of assassination in China, as reported by Boyd (6), was to strike a man having an enlarged spleen over the splenic area. Since these pathologic spleens were easily ruptured, the injured man usually died of internal hemorrhage within a few hours.

DELAYED HEMORRHAGE FOLLOWING TRAUMATIC RUPTURE OF THE SPLEEN

The problem of delayed hemorrhage, following a variable latent period dating from the time of primary injury to the spleen, has been of relatively recent interest. The proper recognition of this "silent interval" has aided in the adequate treatment and lowering of mortality in this group of injuries.

Since McIndoe's series (14) constitutes a selected group representative of the two cases cited, we shall give a brief résumé of his findings to aid in emphasizing factors important in the diagnosis and treatment of these patients.

AGE, INCIDENCE, AND SEX

Since males are physically more active and, as a result of occupational and athletic activity, more subject to abdominal blows and injuries, this group predominates with 81.8 percent as compared to 18.2 percent females. Approximately one-half of the cases were found in children and adults up to 25 years of age.

Simpson (21) reported the earliest age for which rupture of the spleen is recorded—a newborn babe dropped on the floor during a precipitate labor. The oldest reported age was 63 years.

INITIAL INJURY

The spleen, as a rule, is freely movable, attached to its pedicle and to a supporting ligament extending from the lateral parietal wall and from the base of the diaphragm. It is further protected by the elasticity and cushioning effect of neighboring viscera and lies hidden beneath the rib cage; adapted to resist external violence and to retreat before shocks and blows.

There is usually a history of injury and the force producing uncomplicated rupture of a normal spleen is usually sudden, severe, and relatively localized to the splenic region.

During the initial injury the spleen may be hurled against the vertebral column, or cracked or ruptured by contracoup violence. This may explain the frequency of involvement of the hilum with the consequent profuse hemorrhage.

In 44 cases in which the primary injury was recorded, 20 were due to severe accidents, 16 to moderately severe injuries, 7 to slight accidents, and 1 to a spontaneous rupture. In the majority of these cases the force of the blow was directed to the region of the spleen and lower left chest. Associated injuries, such as fractured ribs and injury to the left kidney, may indicate the degree of injury suffered by the spleen.

As a rule, the symptoms suffered as a result of such accidents varied with the severity of the injury. When the abdomen received a severe blow, the patient usually developed immediately a varying degree of traumatic shock. Dizziness, faintness, weakness, nausea, and vomiting, or even complete collapse associated with rapid pulse, pallor, clammy skin, cold extremities, and shallow respiration, were noted. In less severe injuries these signs usually subsided rapidly and patients were able to be helped to their homes or even able to go about their business in a day or two.

Close attention should be given to local symptoms and signs since these are often the only definite evidence of splenic injury.

Pain over the region of the spleen was the complaint in almost every one of the 46 cases reported by McIndoe. This varied from a mere discomfort to a dull ache in the less severe cases; and to a severe, stabbing, paroxysmal pain of great intensity in the more severely injured patients. In only one instance of McIndoe's series did the patient complain of pain radiating to the left neck and shoulder. Case 2 of our series demonstrated this radiation both subjectively and objectively.

Abdominal rigidity, generalized at first but more often localized to the epigastrium or to the left upper abdominal quadrant, was the most frequent sign encountered. "Rigidity in abdominal contusions not limited to the injured point is of paramount diagnostic significance

and is a clear indication for immediate laparotomy. Suspicion of underlying injury to the spleen should therefore always be entertained in spite of the presence of other injuries if after such an accident persistent abdominal rigidity is found in the left upper abdominal quadrant."

Connors (9) summarized the signs and symptoms of splenic rupture, as follows:

1. History of trauma to the left side, sudden and severe in nature.
2. Definite interval between infliction of trauma and patient's realization of serious injury.
3. Pain in left chest or abdomen and shoulder, aggravated by motion.
4. Difficulty in breathing—painful.
5. Signs of internal hemorrhage with shock moderate to severe; subnormal temperature; rapid, thready pulse; pallor; cold perspiration; clammy skin; falling or low blood pressure.
6. Increasing abdominal pain—more pronounced on pressure over left upper quadrant.
7. An increasing area of dullness over the left flank.
8. Rarely nausea and vomiting in the early stages.

LATENT PERIOD

McIndoe considered that the latent period began with the cessation of splenic bleeding and was terminated by the abrupt and sudden onset of secondary bleeding at a date remote from the primary injury. The swift appearance of the signs of internal bleeding does not coincide with the onset of fresh, fulminating hemorrhage but represents either:

1. A rapid failure of the patient's resistance against an increased hemorrhage, or
2. The collapse following sudden evacuation of a constantly augmented perisplenic hematoma into the general abdominal cavity, or
3. A sudden explosive rupture of the splenic capsule from a gradually augmented intrasplenic hematoma with slowly rising intracapsular pressure.

In all cases the abrupt onset of the delayed hemorrhage initiated a grave abdominal disaster, made more serious to the examining surgeon by the apparent absence of an adequate cause, by the difficulty in diagnosis, and by the fulminating character of the bleeding.

The shortest latent period encountered in McIndoe's series was 48 hours; the longest 6 months. The onset of delayed hemorrhage, or the termination of the latent period, occurred most often between the third and the ninth days, and rarely over 14 days. Of the 44 cases studied, 39 were between 2 to 16 days, and 5 were between 17 to 30 days. The time of onset of the secondary or delayed splenic rupture and hemorrhage apparently was not dependent upon the physiological state of expansion or contraction of the spleen. Many of these patients were quietly attending to their affairs, without un-

due effort, when the sudden agonizing attack of pain was felt in the left side or, at times, diffusely spread over the epigastrium, with abdominal rigidity, tenderness, and shock. In others, secondary rupture took place after slight strain, defecation, leaning forward during dressing or during exercise.

Absolute symptomatic silence of signs and symptoms is, however, far from the rule during the interval period. Many of these patients complain of a dull, remittent pain persisting in the left side at the site of the injury. A slight degree of rigidity usually persists in the left upper quadrant, provoked by the slightest examination.

Perrin (16) believed that, if rigidity increased, a more serious lesion than simple contusion of the spleen should be suspected.

Pitts and Ballance (17) stated that a splenic origin of intra-abdominal hemorrhage could be deduced, "from the locality of the injury, from the evidence of internal hemorrhage, from the great increase in fixed dullness in the splenic region, and from the fact that though both flanks were dull on percussion the right flank alone became entirely resonant on change of position."

Fever is usually uncommon in these cases during the latent period. Dullness and a feeling of doughiness in the left upper quadrant with occasional increase in splenic dullness may be a significant sign pointing to the presence of a firm perisplenic mass of clots forming a large hematoma.

Pain in the left shoulder referred from the splenic region was noted in several cases and is often associated with elevation of the left diaphragm.

Saegesser (20) uses the "splenic point," and exerts digital pressure between the sternomastoid and scalenus anticus muscle on the left side of the neck as a diagnostic sign. He has noted that, in all splenic injuries, pressure exerted at this point started up violent pain in contrast with the same pressure exerted on the right side. He has found that this sign is positive and present even when rupture of the spleen is incomplete and when a subcapsular hematoma is present with the capsule intact; and believes that when this sign is positive splenectomy is indicated and justified.

A variant of this sign was discovered by accident in case 2. In this patient it was found that pressure over the left upper quadrant elicited severe pain in the "splenic point" of Saegesser each time pressure was made. The referred pain was severe enough to have the patient place his hand against the left side of his neck to control the pain. It is suggested that this sign be tried in suspected cases of splenic injury to obtain additional information relative to its diagnostic value.

PATHOLOGICAL FINDINGS

The surgeon and pathologist alike are aware of the close parallel which exists between this condition and that seen in ectopic pregnancy, in which delayed hemorrhage also forms a common sequence. This is true but for the fact that trauma may also frequently produce in the spleen what occurs spontaneously in the tube; the essential pathological development of the perisplenic hematoma and the pelvic hematocele being largely identical. The spleen, like the fallopian tubes but unlike the kidneys, is surrounded by a potential space, which in turn is surrounded by easily displaced structures, permitting the formation of a cavity capable of receiving the entire volume of circulating blood.

The various types of traumatic lesion seen in the injured spleen have been described by Blocker (5) under the following headings:

1. Minor capsular tears and contusions of the pulp.

In this group there may be a history of trauma with left-sided pain, but with a minimum of shock, if any, and no signs of internal hemorrhage. Recovery is prompt, and, since the condition is largely theoretical and based upon healed findings, there are, as a rule, no operative findings or fresh pathological specimens. Collin called such lesions "dry rupture."

2. Intrasplenic and subcapsular hematoma, with or without capsular rupture involving the pulp.

In this series, symptoms of internal hemorrhage provide the all important factor in making the diagnosis. Small hematomata may be absorbed, or may increase in size and eventually rupture the capsule with attendant hemorrhage and clot formation. It is from this group that the cases of "delayed" or "secondary rupture" occur. The practical effect of these subcapsular hematomata was to increase enormously the area of the tensely stretched capsule, whose impaired nutrition then predisposed toward secondary rupture.

3. Deep pulp and capsular lacerations with severe hemorrhage into the peritoneal cavity.

All reported cases of traumatic rupture fall into this group. When first seen, these patients presented all of the classic symptoms and signs of hemorrhage and shock. As the hemostatic and tamponading value of clot formation proceeded, it succeeded in many instances in controlling and localizing the resultant hematocele. It is difficult to conceive, however, how in such a vascular organ as the spleen anything more than a weak, fibrous union can take place between the resultant clot and the two

soft and friable surfaces. These can become easily dislodged under activity, and active bleeding may recommence. The frequency with which a tongue of omentum insinuates itself between the margins of the rupture or plasters itself over the wound was frequently commented upon in reported cases. The early union is rather fragile but later becomes firmer and less easily separated. "Omental plugging, combined with the tamponading effects of the subjacent clots, offers the most usual method of immediate and temporary hemostasis."

4. Complete severance of the pedicle or detachment of large pieces of spleen tissue.

This group represents the most violent types of traumatic injury, those usually fracturing the spleen into two or more sections and involving the larger splenic vessels and intrasplenic branches. This type of spleen rapidly develops a large perisplenic hematoma augmented from within by a rapidly extending pool of extravasated blood. It is this type which may show progressive shock with often a fatal outcome before adequate measures can be instituted. Twelve cases of this type have been reported in the literature, with the spleen fractured into two or more pieces, and in only eight cases has complete avulsion of the spleen been reported.

STATUS OF HEMORRHAGE DURING LATENT PERIOD

The latent period is largely dependent upon the degree and type of bleeding and its method of control, since the time required for hemorrhage to cease will vary with the type of injury. In the small intrasplenic lesions hemostasis will be more or less complete within a few minutes or hours. If more extensive subcapsular extravasation was occurring, the hemostatic process would probably be prolonged over a period of days with intermittent minor extravasation after the initial bleeding had been controlled by the resistance of the capsule.

After capsular rupture and perisplenic bleeding, hemostasis would be much more difficult to establish and maintain.

The history of frequent recurring attacks of left upper-abdominal pain, tenderness, progressive weakness, anemia, and increase in left upper-quadrant dullness during the latent period indicates that perhaps fresh bleeding has been occurring intermittently and that the primary hematoma has been increasing in size. However, when hemostasis is temporarily complete, attempts at healing may even take place during the latent period.

Secondary hemorrhage, which terminates the latent period, usually occurs when the tensely stretched capsule overlying an intrasplenic

hematoma gives way suddenly at that portion of the capsule, weakened by the original trauma, which has been softened by surrounding inflammatory changes and interference with its trabecular blood supply. Full escape of blood into the splenic pouch and peritoneal cavity is thus permitted. In such cases bleeding once restarted becomes profuse and rapidly uncontrollable except by splenectomy. In seven cases reported by McIndoe, hemorrhage was so overwhelming that the peritoneal cavity was literally flooded and death occurred within a few minutes. In most cases the entire left abdomen was ultimately occupied by the rapidly expanding hematoma which at times extends into the pelvis. Occasionally this hematocele may remain localized, to the end, in the perisplenic area without reaching the general peritoneal cavity.

Many of the reports from the literature recorded the fact that ruptures found at operation and necropsy were much larger and more extensive than could have been inflicted by the original injury. It would thus seem to indicate that the episode of secondary hemorrhage occurred with such a degree of violence that it had a shattering and disintegrative effect on the spleen, so intense at times as almost to sever the spleen from its pedicle, as well as to disrupt the intrasplenic integrity. Whether this phenomenon occurred as a sudden explosive effect or following a gradual course is difficult to evaluate. One may even state that a much smaller initial and oft-forgotten primary injury to the spleen may have as its end result at operation or post mortem the extensive lesions of spleen frequently seen, seemingly without adequate cause to explain their presence.

TREATMENT

The treatment of choice for rupture of the spleen is splenectomy. Attempts to repair or tamponade the ruptured spleen have proved ineffective. The left rectus incision described by Bevan (4) and others has proven a satisfactory method of approach, although the wide transverse left subcostal incision described by Ruggi (19) has received favorable acceptance. We have favored the Balfour (1) method of packing a continuous gauze roll into the cavity, superior and lateral to the spleen, by which maneuver the spleen is gradually brought forward into the incision and, in event of splenic fracture, bleeding comes under control. Should the patient's condition warrant supportive treatment during the operative period, pooled human plasma may be given as a substitute for a blood transfusion in event suitable donors are not immediately available. Repeated blood transfusions are indicated in those patients who have suffered a depleting blood loss. Autotransfusion of filtered free abdominal blood may also be considered as a life saving measure if neither donor nor plasma is

available, but only in those cases of primary rupture of the spleen with intra-abdominal hemorrhage.

In the presence of confusing associated pathology an abdominal tap may be invaluable in diagnosis.

The anesthesia of choice should be the open drop-ether method since spinal anesthesia in the presence of shock or the impending shock of hemorrhage would be contraindicated.

Wound healing is occasionally inhibited after splenectomy, as is indicated by the rather high percentage of wound disruptions reported. Maintenance of an adequate serum protein level together with a high vitamin C dietary regimen may do much to counteract this tendency.

MORTALITY

In McIndoes's series of 46 cases, 37 were operated upon with a mortality rate of 27 percent. Of the 9 patients not operated, 8 died on the table or within 48 hours of operation from hemorrhage and shock, and 1 recovered. Reported series of cases of traumatic rupture of the spleen give a mortality figure of around 33 percent. Lotsch (12), in 1908, reported 138 cases with a mortality of 37.7 percent; Planson (15), in 1909, reported 140 cases with a mortality of 37.1 percent; whereas, Buxton (8), in 1922, found the mortality for all cases up to that time to be 28.8 percent. In 220 cases not operated, Berger (3) found a mortality of 92.3 percent, whereas Watkins (22), in his report, gave the mortality rate as 100 percent.

Of 49 cases of wounds and ruptures of the spleen reported from the A. E. F. (11) during World War No. I, two-thirds showed complicating lesions (varying from perforating wounds to complete avulsion of the spleen and multiple fracture); and the operation of choice was given as tamponade, since splenectomy was quoted as giving practically a 100 percent mortality. The mortality rate in all cases was given as 62.3 percent.

SUMMARY

1. Two cases of traumatic rupture of the spleen with delayed hemorrhage are reported, occurring 38 days and 4 days, respectively, after the original injury to the spleen.

2. One case of spontaneous rupture with probable delayed hemorrhage is reported.

3. A brief review is given of the syndrome and of the clinical and pathological processes observed as a sequence to the initial injury. The latent period becomes a definite entity in this syndrome and its recognition and clinical importance should aid in establishing the diagnosis before secondary hemorrhage can occur.

4. Four distinct types of pathological entities in ruptured spleens are described.

5. Secondary hemorrhage is described as a decided factor in influencing mortality rate, which is equally as high as that encountered in primary rupture.

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SHOCK¹

ITS NATURE AND THERAPY

By D. W. WHEELER, Lieutenant Commander, Medical Corps, United States Naval Reserve

Experience with wartime casualties, up to the present time, shows that a large number of cases of extensive burns, compound fractures, multiple flesh wounds, and blast injuries are certain to result. The common factor in all such conditions is shock. Let us first define shock, discuss the theories pertaining to it, describe two types of shock, giving initiating, accompanying, and perpetuating factors of the secondary type, after which we will consider the cause and effects or clinical picture, and its prevention and therapy.

Shock is difficult to define satisfactorily. In my mind, the most adequate definition is, "Shock is a symptom-complex resulting from a 'progressive vasoconstrictive oligemic anoxia'" (1). The disturbance in circulatory dynamics, common to all varieties of shock, is a discrepancy between the effective circulating blood volume and the volume capacity of the vascular bed. The clinical features of shock depend upon this fact, as well as upon the effects of ischemia and anoxia on the central nervous system and peripheral capillaries. Once established, the state of shock may persist as a vicious circle.

There are remote and immediate causes of shock. Among the predisposing causes are fear, anxiety, cold, hunger, and dehydration. There are important racial and personal factors. The immediate cause of shock includes any severe injury, which allows fluid to escape from the vascular tree by one or more of three avenues, namely: The extravascular loss of blood, such as hemorrhage, intravascular loss of blood by stagnation from vasodilatation or vascular paresis, and the transudation of plasma through damaged capillaries or from skin surfaces, such as burns.

Physicians are all familiar with the anxious, restless patient, breathing by rapid, shallow efforts, intermingled with sighing due to air hunger. The pale, ashen face covered with cold sweat and purple-red mottling of the body are visual evidence of the state of shock. The

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patient has an unquenchable thirst which is not relieved by fluid intake, and vomiting adds to the loss of fluid. The pulse is rapid, small of volume, and thready, the veins are visible in their collapsed state. The hands and feet are cold and the tips of the toes and fingers are slightly cyanotic. The systolic blood pressure, if taken, registers about 80 mm. Hg. and the diastolic pressure is impossible to record accurately. This is the picture of a patient in shock, and yet many times in practice it is unrecognized and untreated. Measures taken early can reverse the whole cycle of pathologic-physiology and save a life otherwise lost.

The common determinant in all types of shock is the diminution in venous return to the heart, due to a loss of blood volume. Shock is divided into primary and secondary types. Primary shock is immediate, following injury, fear, or surgical procedure and is known as syncope. It is characterized by a sudden loss of venous return to the heart due to sequestration of blood in the splanchnic area and an immediate fall of blood pressure. There are vasodilatation, warm extremities, and normal or slowed pulse. "The very rapidity with which the symptoms of primary shock develop, speaks strongly for their nervous origin, for which reasons the condition has been termed neurogenic shock." (2).

This disturbance of physiology seen in primary shock is amenable in its early stages to vasoconstrictor drugs and the administration of fluids. Primary shock may continue and establish secondary shock.

Secondary shock may not appear for several hours or a day. This delay has been attributed in war injuries to the fact that the wounded man often bleeds slowly over a considerable period of time. He is transported long distances in a stretcher exposed to cold; both are factors which bring on shock where it could be averted under the conditions in civilian practice.

Three theories of shock have received the most attention: That of vasomotor paralysis so strongly advocated by Crile (3) 40 years ago, and the failure of venopressor mechanism as outlined by Henderson (4), later refuted by Cannon (5), have almost been abandoned. The third theory, resulting from Keith's (6) and Mann's (7) brilliant studies, that of a decrease in circulating blood volume is most generally accepted today. This theory has been substantiated by Phemister and Parsons (8) and Blalock (9).

In all severe injuries, there is a loss of blood volume from hemorrhage into the tissues or outside the body. There is transudation of plasma into the tissues, a pooling or sequestration of blood in the capillaries and sinusoids. Blood thus stagnated in dilated capillaries is removed from circulation almost as efficiently as if it were extravasated; as the circulation through the dilated capillaries is so slow that they contribute very little to the venous return to the heart. One of the aforementioned causes, the effective circulating blood volume is

greatly diminished. The result of the loss of blood volume is a reduced venous return to the heart (decreased effective venous pressure), a failure of diastolic filling of the ventricles and a reduced cardiac output. "Decreased systolic discharge accounts for the feeble heart sounds and apex beat, the small pulse pressure and the feeble thready pulse. The peripheral veins are visible evidences of reduced venous return from the limbs" (10). Most investigators agree that capillary stasis, transudation and decrease in the circulating volume initiates the changes responsible for peripheral circulatory failure.

The loss of blood volume automatically causes a vasoconstriction; this is nature's way of protecting circulation to the vital centers in the central nervous system and this vasoconstriction may do actual harm to the organism.

Perhaps the most important adaptation of the circulation to the diminished cardiac output resulting from the oligemia of traumatic shock is the peripheral vasoconstriction. In early shock, the blood pressure is maintained, evidently the vasoconstriction atones for the diminished cardiac output. Later the diminution of cardiac output gains the upper hand and the arterial pressure falls. The decreased cardiac output occurs not because the myocardium is depressed but because an insufficient volume of blood returns to the heart, permitting nutritional defects in the cell metabolism. The increased circulation time causes less oxygen distribution and as the oxygen debt mounts, it becomes more difficult to repay. The increase in circulation time may be the first sign of the progression of shock. The reduced volume of blood flow is important and progressive and is considered one of the prime factors in shock.

One of the early, easily determined but significant features in the pathologic-physiology of shock is the increase in ratio of erythrocytes to plasma per unit-volume of blood, called hemoconcentration. Some writers (11) attribute hemoconcentration to the transudation of the plasma, leaving the cellular elements in the vascular system. This presupposes an increased permeability of the endothelium and the loss of plasma seriously damages the movement of fluid between the blood and the tissues. This movement depends upon the action of several factors including capillary blood pressure, osmotic pressure, electrolytic concentrations and hormonal substances. The presence of a semipermeable membrane, the endothelium, is absolutely essential in preserving a physiologic relationship between intravascular and extravascular fluids. Other investigators (1) mention the addition of red corpuscles from the spleen and from surface capillaries as a cause of hemoconcentration.

At this stage there is a decreased oxygen content of the venous blood and a definite disproportion in the arteriovenous oxygen content indi-

cating that the mechanism of compensation is failing. There is a fall in blood pressure to the critical level, where if it remains a few hours, any measures used will not cause it to rise again. There is an increase in heart rate and a diminished renal excretion due to ineffective renal circulation. The late appearance of the fall in blood pressure definitely shows that it is an inadequate guide as to the state of circulation in incipient shock.

As compensatory factors of circulation fail, a gradual progressive anoxia develops which causes a self-perpetuating vicious circle which is usually irreversible. We now have the one most important feature of shock, namely: Its irreversibility.

The importance of anoxia has been mentioned by many writers (5) (11) (12) (13). Moon states, "Anoxia probably is the most important factor tending to increase or perpetuate the circulatory deficiency." Anoxia increases the permeability of the capillary walls to such an extent as to permit the passage of the plasma proteins and thus reduces the effective osmotic pressure and aggravates once more the failure of circulation. The sympathetic nerve tonus is relaxed by asphyxia permitting further dilatation of the capillaries. The decrease in oxygen consumption produces a lower metabolism and a fall in body temperature which is uniform and progressive. In the advanced stages of shock there is a decrease in coagulability of the blood, a fall in blood chlorides and an increase in the blood sugar and nonprotein nitrogen. There is a decrease in the carbon dioxide combining power of the blood without evidence of acetone on the breath and without Kussmaul type of breathing. Wiggers (10) challenges "a common view that anoxia or asphyxia of a degree, which is probable, could produce the severe reactions." This series of disturbances in physiology usually develops over a period of several hours.

There are undoubtedly other perpetuating factors such as hyperpotassemia, adrenal medullary overaction, and adrenal cortical insufficiency—possibly histamine and tissue metabolites. Scudder (14) and his associates have recently reemphasized the importance of the potassium concentration in the blood during shock. The concentration of potassium in the blood comes on late in shock and is associated with general cell damage. It may be a factor in perpetuating the syndrome of peripheral circulatory failure. The potassium concentration is greater in stored blood and it is well to know that there is enough potassium in three liters of blood to cause death. Therefore, avoid large transfusions of preserved blood or give it very slowly in emergency. The increase in blood potassium and the decrease in blood sodium may be similar to Addison's disease and indicate an exhaustion of the adrenal cortex. If this is true, then adrenal cortical hormone should be the cure of all shock cases.

There are many advocates of the toxic theory of shock. This theory has been denied by the experimental work of Phemister and Handy (15) and by Blalock (9). A great blow to the histamine theory of shock comes from the paper of Dragstedt and Mead (16). They tested the blood and thoracic duct lymph of dogs for histamine and got positive results where histamine had been the cause of shock but similar dogs suffering from traumatic shock gave negative analysis. The question whether histamine and tissue metabolites are or are not secondary to anoxia remains unsolved.

Boothby (17) has shown that a fall of body temperature of 5° F. causes a demonstrable reduction in the dissociation curve of oxygen. Increasing the body temperature raises the dissociation curve which in turn increases the oxygen tension of the tissues.

The old adage, "An ounce of prevention is worth a pound of cure," is particularly applicable in the treatment of shock. Once the characteristic clinical picture of shock is apparent, we find that the irreversible features of this condition have progressed to the point where it becomes a problem merely to maintain the life of the patient.

Owing to the inherent nature of warfare, the fighting forces are subjected to periods of long exposure in all kinds of climate, to rations which are meager and inadequate, to the lack of water, to nervous and physical strain of fighting. The lack of adequate protein and water in diet makes the fighter more vulnerable to trauma and infection. To prevent shock, every effort must be made to restore these deficiencies by sufficient fluid intake, adequate food providing a large amount of protein and essential vitamins. Warm, dry clothing should be provided as soon as available.

It becomes the duty of every medical officer to understand the four methods of controlling hemorrhage:

1. Cover bleeding wound with a tight dressing with the part elevated.
2. Pack the wound with sterile gauze and apply pressure over the artery supplying the area.
3. Ligate large visible bleeders.
4. Apply a tourniquet if all other methods fail.

If a tourniquet is resorted to, then every hour it should be released to prevent stasis of blood and tissue anoxia with the resulting increase of capillary permeability. Otherwise, the tissues become boggy and resist infection poorly. Adequate splinting of fractured bones reduces the tissue damage and prevents the compounding of fractures. Such precautions are of prime importance in preventing shock.

The importance of cold in aiding the development of shock was shown by the Shock Committee during the First World War. Warmth, then, certainly seems advisable, but too generalized heat of too high a degree might precipitate a too sudden capillary dilatation

increasing the deficiency between blood volume and volume capacity of the vascular system. Hot drinks should be given as soon as possible.

The use of vasoconstrictive drugs in secondary or hematogenic shock seems contraindicated because there is already vasoconstriction present and its continuation would be distinctly harmful to the individual. A perusal of the work on the production of shock by adrenalin alone would certainly make one hesitant in using that drug in the treatment of shock.

The use of sedative drugs, such as the barbiturates, retards the development of shock (18) and is of value in gaining rest and quiet. Morphine is advised in $\frac{1}{2}$ -grain doses except in head injuries. Cannon warned against its use because it may exaggerate any anoxia present.

Since the initiating factor of shock is a reduced blood volume due to loss of fluid, the treatment of the underlying pathology by replacement of fluid is in reality the *sine qua non* of shock therapy. Of the six avenues of administration, two are rapid enough to be effective, namely the intravenous and intramedullary routes (19). The difficulty of getting into the collapsed veins of a patient in shock is well known and physicians should be prepared to cut down and cannulate the vein if necessary. Intramedullary infusion of crystalloids and colloids including blood and plasma is worthy of trial. The oral, orojejunal, and rectal routes are valuable in adjunct feeding in hypoproteinemic states but not dependable nor rapid enough in emergency treatment of shock. The subcutaneous use of fluids such as normal saline or 5 percent glucose are definitely contraindicated. The transudation of plasma into the tissues and the loss of protein from the blood stream will prevent the drawing of tissue fluid back into the circulation. Intra-arterial injection of hypertonic solutions, although immediately effective in raising blood pressure and improving circulation to the vasomotor centers, seems to hasten rather than delay death.

The fluids that are available for intravenous use are listed below :

1. Water.
2. Crystalloids (normal salt solution, Ringer's solution, Locke's solution) and glucose.
3. Acacia.
4. Ascitic fluid.
5. Whole blood (also red cell concentrate and hemoglobin—Ringer's solution).
6. Plasma or serum.

The relative inefficiency of the crystalloids in the treatment of shock due to hemorrhage has been demonstrated by many investigators (12) (20) (21) (22) (23). Intravenous injections of saline solutions are ineffective due to the permeability of the capillaries which allow the solution to pass rapidly into the tissues, almost before completion of

the venoclysis, carrying the valuable plasma proteins with them. This loss of plasma protein affects the osmotic pressure adversely.

The prevention and treatment of dehydration is important in the shock syndrome. Salt solution has a definite place in therapy when we realize its limitations. Hypertonic solutions were thought to resemble plasma or blood because of their viscosity and their osmotic pressure. Both of these virtues may be evils at the same time and in dehydration may increase the blood volume at the expense of the all important cell water. Glucose has little advantage over salt solutions except as a nutriment and protection to the liver.

The aim in the treatment of delayed shock is the restoration of the blood volume. The prompt administration of a colloid solution to replace the loss of fluid, elevates the blood pressure and provides a vehicle for the circulation of the red blood cells which is necessary to overcome the tissue anoxia.

A 6-percent solution of acacia (24) has much the same viscosity as plasma. It is an inert polysaccharide and was often used on the western front in World War I (25). Acacia enjoyed wide popularity at the Mayo Clinic where 3,000 intravenous injections were given before 1932. Acacia alone raised the blood pressure an average of 35.5 mm. Hg. and the pulse rate became lower. It is safe, ready, and inexpensive. Two advantages that acacia has over whole blood are availability and portability, but this is not true in comparison with plasma. It has less therapeutic value and causes considerably more damage than plasma. The disadvantages or dangers of intravenous acacia solutions are numerous:

1. There is a small percentage of nitrogen present in acacia which may account for the occasional anaphylactoid reaction (26) after multiple injections when there is a period of time between injections.

2. Extensive acacia deposits are found in the liver and bone marrow, lungs, spleen, and kidneys.

3. Once acacia is administered, blood counts, blood typing, and cross-matching become difficult, as is well known. Acacia (27) coats the red cells and interferes with their respiration, increases the tendency to rouleaux formation, accelerates the sedimentation rate, and causes a conglutination of the red cells with the possibility of capillary blockage.

The only indication for the use of acacia today is as a last resort where blood, plasma, or serum are not available. Acacia has been of benefit in the past but today there are other more perfect blood substitutes. Plasma has all the advantages and none of the disadvantages of acacia.

Ascitic fluid has been used as a blood substitute experimentally. It was found to be sterile and bacteriostatic but not devoid of agglutinins. Agglutinins can be removed and the ascitic fluid rendered safe for intravenous use by a process (28) of electro dialysis, adjustment of the

pH and filtration through a Berkefeld filter. The lyophil (29) principle can be applied to ascitic fluid. The dried ascitic fluid can be redissolved readily and can be used in various concentrations. Blood pressure and oxygen consumption usually returned to normal in animals. So far, ascitic fluid has not been used in the human.

Whole blood used in transfusion has all the qualifications for restoring the lost fluid in shock due to hemorrhage. In other forms of shock with hemoconcentration, the cellular elements of blood are so plentiful that plasma or serum replaces the fluid element adequately. Whole blood has been recommended over 200 years. Under the actual conditions of war many disadvantages appear immediately. The laboratory facilities for testing, typing, and cross-matching are far behind the lines due to the rapid mechanical type of present-day warfare. Whole blood must be kept at 2° to 5° C., for preservation. This means heavy refrigerating units must be available. Stored whole blood remains in good condition for 7 to 10 days although blood 30 days old has been used without any reaction. The red blood cells (30) when fresh will survive in the recipient's blood stream for 95 days while blood 3, 10, and 14 days old will remain in the blood stream 80, 60, and 20 days, respectively. The possibility of potassium poisoning following the use of stored blood I have already mentioned; also the necessity of slow transfusion for safety. There are the occasional dangerous reactions following transfusion from agglutinins and the occasional intravascular hemolysis. The suppression of urine, hemoglobinuria, and renal tubular damage can be prevented (31) by a high urinary output of at least 1500 cc. per day, and a constant urinary reaction of pH above 6.4. Fluids and alkali by mouth will prevent intravascular hemolysis.

Massive or adequate transfusions are advocated by the Mayo Clinic (32). The customary pint transfusion is a heritage which fits the donor but not always the recipient. Lundy, Tuohy, and Adams would like to change this conception and administer the amount necessary to supply the patient adequately with blood even up to 2,000 cc. taken from several donors. Some dramatic results follow massive transfusions. DeBakey (33) practically denies the possibility of "speed shock" and has transfused "not infrequently" as much as 650 cc. of whole blood in 3 minutes.

To get away from the necessity of searching for donors where minutes might determine the outcome of a severely injured person's life, a blood bank or depot originated at Cook County Hospital in Chicago, and now many cities and some foreign countries have developed them. A collection of blood to be drawn upon in any emergency eliminates the time consuming finding, typing, and cross-matching, and serologic testing of a donor at the time of an accident. This blood is replaced

in the bank, after the crisis passes, by friends or relatives of the patient. The arrangement replaces the older blood in the bank and keeps a revolving supply of fresh blood available.

After violence as has occurred during this World War II, we realize the necessity of preparedness during a blackout or bombing, and with a demoralized populace the sudden demand for large quantities of blood would create a real problem. The blood bank is the answer to this problem. Thus, blood is available at any time for transfusion.

Several types of whole blood have been used in transfusions for hemorrhage and shock. The direct transfusion of whole blood or citrated blood is valuable, but its practical difficulties outweigh any theoretical advantages it may have and its usefulness in warfare is greatly narrowed. Citrated preserved blood makes up in practicability any theoretical disadvantages it may have. Placental blood can never be supplied in a large enough quantity for wartime purposes and besides it is frequently infected. Cadaver blood requires that a large number of fresh cadavers are available which is not possible in American cities. The cadaver yields a greater quantity of blood, and its use causes a higher percentage of reactions. This type of blood is used especially in Russia by Youdine.

Elliott (34) found plasma to be beneficial in shock and that the erythrocytes in a blood transfusion played a little part in the benefit received. Mann (35) used dog serum for the relief of experimental shock as well as whole blood.

Plasma is as effective as whole blood in the treatment of shock in humans. The restoration of blood volume by infusion of plasma rather than red cells is the logical treatment. The loss of red cells from the body is unimportant unless it is accompanied by a sufficient loss of plasma to reduce the blood volume and cause shock. Red cells do not exert an appreciable colloid pressure and administration of red cell concentrate does not substantially increase blood volume or pressure. Blood plasma is therapeutically equivalent to blood in hemorrhage cases although not generally recognized.

The previous remarks have been confined to liquid plasma. Since machines have been developed for drying biologicals (36) (37) dried plasma is a reality. Many methods have been used to dry plasma and each is a modification of the crudest, i. e., evaporating in an open vessel. The advantages of dried plasma outweigh all other substitutes for blood—it can be preserved almost indefinitely, at least three years, the bulk and weight is reduced, it is easily reconstructed by the addition of distilled pyrogen-free water to the powder, it can safely be given in two or four times concentrated forms, it does not have to be warmed prior to injection, and it can be given rapidly intravenously.

There are several manufacturers who make complete collecting, pooling, and storage sets with the needle and tubing attachments. The vacuocollecting bottle is dumbbell in shape so that a small interface between the plasma and the blood cells occurs. The importance of this small interface is to prevent excessive hemolysis and less electrolytic exchange. The closed citrate method is used. After the blood is collected from the donor under strictly aseptic technic, the blood remaining in the tubing is used for serology—blood typing and cross-matching. Each donor gives 500 cc. of blood and with the citrate each bottle contains 550 cc. Approximately 200 cc. of plasma separates from the blood cells. After refrigeration for 6 days at 5° C., the plasma is siphoned off into large two-liter pooling flasks. Each pooling bottle contains the blood of 10 donors. The dilution of the different agglutinins is sufficient to inactivate them so that reactions occur rarely if ever in the recipient. Aerobic and anaerobic cultures are made of each plasma specimen after pooling. After 10 days the plasma is drawn from the pooling bottle and collected in storage bottles which can be inverted and used for transfusion sets. The bottled plasma is returned to the refrigerator where it can be quickly frozen at -12° C., or stored in the liquid state at 20° C. Plasma in the frozen state is allowed to melt at room temperature so that flocculation of fibrin will be minimal. Plasma must be filtered before being used through a Gooch fiber filter made of pure crystalline asbestos or a special metal screen. There are four types of plasma used today:

1. Natural plasma.
2. Preserved plasma.
3. Calcificated plasma or serum made from plasma by the addition of 20 cc. of 8 percent sterile calcium chloride to each liter of plasma.
4. Dried plasma which may be concentrated or reconstituted.

A simple method to determine whether adequate plasma or serum has been given is to determine the cell pack volume of the patient's blood. The normal percentage is between 40 to 50. For each point above 50 percent give 100 cc. of plasma every 24 hours. The hematocrit reading gives similar results. The concentration of hemoglobin and the high red cell count are also aids in determining hemocentration.

The inherent disadvantages of plasma are:

1. The fibrinogen fraction is unstable and tends to precipitate more and more on standing. Filtering becomes essential before its administration.
2. The separation of plasma from cells involves a good deal of manipulation with a considerable chance of contamination.
3. The use of a bactericide or bacteriostatic substance has been recommended such as 1:10,000 merthiolate or 0.5 gm. of sulfanilamide per liter.

The advantages of plasma are numerous:

1. It is adequate in restoring the blood volume in shock.
2. It can be made and stored in large quantities.
3. It can be given without typing.
4. It can be made from blood bank.
5. It passes through a bacterial filter, insuring sterility.
6. It may be used in concentrated forms.
7. It may be used in large quantities rapidly.

Infusion of adequate amounts of plasma is extremely important in relieving shock. Failure of a severely wounded and shocked patient to recover after receiving 2 to 3 pints of blood or plasma probably means that further quantities must be administered. In some severely burned patients, as much as 8 to 11 quarts were used in individual cases.

The plasma requirements are probably much larger than was originally believed. One or 2 (250 cc.) units are hardly sufficient for shock therapy in the individual case. In burns, very large amounts of plasma may be required, because of serum losses through the burned skin surfaces. A 10 percent burn requires 2 liters of plasma within 24 hours and further requirements depend on the success of "tanning" measures. Other intravenous fluids may be given but never in amounts greater than the amount of plasma used. Plasma, as used in the treatment for shock, is valuable chiefly for its protein content. Fresh and freshly frozen plasma may supply antibodies, complement and prothrombin, but stored wet plasma or desiccated plasma do not.

Other blood substitutes are not entirely satisfactory or available now. Purified human albumin or lyophil human albumin is adequate in the treatment of shock but the difficulties in preparation preclude its general use at present. Bovine plasma and albumin are still in the experimental stage but in the future may be prepared for human use. Pectin, a carbohydrate of high molecular weight, has some promise but still is in the experimental stage.

The importance of oxygen in the treatment of shock is stressed to relieve anoxia. Oxygen may be used through a nasal catheter or by oxygen tent but preferably with the B. L. B. mask (38). The mask permits the use of 100 percent oxygen, which percentage will increase the oxygen tension of the blood 10 to 15 percent (17). The distribution of oxygen throughout the tissues of the body helps to prevent the further development of the irreversible feature of shock. All shock patients should receive oxygen, possibly with 5 percent carbon dioxide in cases where respiration is deficient.

The use of adrenal cortical extract (39) in therapy of delayed shock is still in the experimental stage. It seems to offer great promise. It may act either by reducing the hyperpotassemia or by decreasing the abnormal permeability of the capillaries.

There are two and possibly more biologic factors (4) of importance which must be controlled by adequate diet, perhaps by transfusions of blood or plasma; the role played by plasma proteins in the healing and repair of wounds and in the prevention of infection, and the loss of protein from the blood stream in shock are well known. Adequate proteins in the diet readily benefit a hypoproteinemic state, but in shock, speed and quantity in replacement by transfusions of blood plasma or serum are essential.

The usual transfusion of blood contains only 17 gm. of plasma protein (41); it takes several transfusions to maintain protein balance, let alone restore a deficiency.

Whipple (42) has shown that body protein stores, protein production and protein wear and tear are in a nicely balanced or steady state in a dynamic equilibrium. These proteins can pass readily from the plasma into cells and the reverse, without loss of nitrogen. Adequate proteins in the diet are building stones for plasma proteins but if additional large quantities of plasma protein are given by vein, there may be an intoxication. Administration of abundant carbohydrate and fat are necessary to prevent this intoxication.

The National Research Council recommends the following vitamin requirements for general nutrition and wound healing: Vitamin A, 5,000 U; thiamin, 2 mg.; ascorbic acid, 75 mg.; riboflavin, 3 mg.; nicotinic acid amide, 20 mg.; and vitamin D, 400 U.

SUMMARY

I have given as a definition of shock, "A progressive vasoconstrictive oligemic anoxia." Initiated by a loss of blood volume, it is continued by a series of physiologic disturbances, namely lessened venous return to heart, decreased cardiac output, reflex vasoconstriction, hemoconcentration, fall in blood pressure, ischemia and anoxia, and is perpetuated by hyperpotassemia, adrenal cortical insufficiency or adrenal medullary overaction, histamine or tissue metabolites, and possibly nervous factors. The sequence of pathologic physiology produces a characteristic clinical picture.

The therapy of shock is adequate replacement of fluids of the proper kind; replace the same type of fluid that is lost, namely plasma. The major part of treatment is plasma replacement. There are other adjuvants of therapy such as adequate oxygen, possibly adrenal cortical substance, but always sufficient protein intake as well as carbohydrate and fat. Vitamins are essential to proper utilization of food.

Plasma is the keystone of therapy—whether liquid or dried, natural or concentrated makes little difference as long as the quantity is sufficient—the prevention of shock is the most important part of therapy.

Prevention includes the replacement of fluids before shock is fully developed. Once the vicious circle is started, it rapidly becomes irreversible.

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THE USE OF LOCAL ANESTHESIA IN THE TREATMENT OF CONTUSIONS AND SPRAINS¹

By HENRY J. BAKST, Lieutenant Commander, Medical Corps, United States Naval Reserve, and GEORGE W. McCORMICK, Lieutenant Commander, Medical Corps, United States Naval Reserve.

The demands of military necessity often require that patients be returned to a full duty status with as little loss of time as possible. In outlying bases, or on board ship where the replacement of personnel is not always feasible, the absence of a single individual from his assigned task may be of considerable importance. Any means, therefore, which will reduce the expected number of sick days in any given condition is worthy of note. If this should prove simple, easily accomplished, and readily adapted to general usage it becomes increasingly noteworthy.

With these obvious facts in mind, we have been devoting particular attention to the consideration of temporarily disabling lesions such as severe contusions and sprains, in an effort to reduce the expected period of absence from duty. The use of local anesthesia in producing a shorter and milder course in patients suffering from articular traumatism was advanced by Arnulf and Frieß (1). Leriche and Froelich (2) obtained excellent results in certain types of fractures, and Moynahan (3) advocated the use of this method in the treatment of sprains. More recently the value of treatment along these lines was again emphasized (4). The application of a similar treatment for the management of rib fractures was apparently first suggested by Zoppi (5), and later, Rovenstine and Byrd (6) reported on the utilization of regional nerve block during treatment for fractured ribs. A thorough discussion of the treatment and additional supporting evidence of its value was recently published by Harmon, Baker, and Kornegay (7), following the report of Outland and Hanlon (4) on the use of procaine hydrochloride as a therapeutic agent.

It may be of value to review briefly the various implications of successful treatment by this method. The advantages appear to be obvious, and may be summarized as follows:

1. Pain is immediately and completely relieved.
2. An immediate full duty status often is possible.
3. The use of sedatives and narcotics is unnecessary.
4. The patient often requires little further observation and may be followed as an out-patient.
5. In chest injuries, excessive coughing is reduced and normal respiratory movements are possible.
6. The treatment is essentially a minor procedure and may be carried out with a minimum loss of time and effort.
7. The not infrequent skin injuries are avoided in those situations where extensive adhesive strappings have been the rule.

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The precautions to be observed are few; an aseptic technic must be followed, and it is assumed that one must be careful of occasional instances of sensitivity to procaine hydrochloride, although we have actually encountered no such case. One definite contraindication is clear, this method is not adaptable to open and dirty wounds.

TECHNIC

The apparatus necessary is simple and uncomplicated. Harmon, Baker and Kornegay (7) used a 0.5 percent solution of procaine hydrochloride and a 0.1 percent solution of eucupine dihydrochloride to which epinephrine was added (10 drops per 100 cc.). This combination provided a more lasting initial anesthesia. For our purposes, however, we have noted that a 2 percent solution of procaine hydrochloride itself was sufficient to give entirely satisfactory results. In addition to this all that is needed is sufficient material to create a sterile field, hypodermic and intramuscular needles, and a 20-cc. syringe.

It has been our custom to use tincture of merthiolate for skin sterilization, and to make a preliminary intradermal wheal with procaine directly over the center of the affected area. Through this wheal it is then possible to introduce the anesthetic into the deeper tissues. As a rule 10 cc. of procaine is adequate, but occasionally 15 to 20 cc. have been used. A sterile gauze dressing is then placed over the site of the injection, and the patient told to report if there is any recurrence of pain. This in brief has been all that has been found necessary in the management of chest injuries. In all instances there has been complete relief of pain and discomfort immediately following this procedure. In from $\frac{1}{2}$ to 2 hours there may be some return of pain but this usually abates during the course of the next few hours. None of these cases required a second infiltration. However, all were severe chest contusions with no fracture noted by subsequent x-ray study. We have found it entirely satisfactory to relieve pain and discomfort as soon as the patient presents himself, and to take x-rays after this object has been attained.

The technic in the treatment of sprains has been similar to that just described, and is essentially that of Leriche and Arnulf (8). The point of choice for injection is usually the point of maximum tenderness, and the involved ligament is also injected. The amount of procaine varies up to 20 cc. The patient is afforded immediate relief of pain and although there may be some recurrence it is usually mild and does not interfere with activity. Occasionally the procedure must be repeated.

Lumbosacral and sacro-iliac strains have been treated by a similar technic, except that a spinal-puncture needle is essential. The

method followed has been that of Haldeman and Soto-Hall (9). The needle is inserted at a point over the sacrum midway between the two posterior superior spines of the ilia, and then directed laterally so as to make an angle of 45° with the skin. The object is to obtain a fan-shaped area of infiltration along the posterior aspect of the sacro-iliac joint. Manipulation may then be attempted to determine whether or not adequate infiltration has been accomplished. Lumbosacral strains have been infiltrated at the point of maximum tenderness.

REPORT OF RESULTS

To date 30 cases have been treated.

	Cases
Contusion of chest wall.....	6
Ankle sprains.....	19
Back injuries:	
Sacro-iliac.....	2
Lumbosacral.....	3

Since we have instituted this method of treatment we have encountered no instances of rib fracture. The six cases treated were all contusions of the chest resulting from severe blows. When first seen they were considered as possible fractures, and gave histories of sudden direct force applied to the chest wall. Complaints were similar in all cases, namely, severe pain and tenderness over the site of the injury with pain on respiration. The results were entirely uniform, immediate relief of pain invariably followed infiltration and the patients were able to return to duty at once. In no case was it necessary to repeat the infiltration.

Of particular interest is the case of P. K. W., machinist's mate, second class, with the history of having stumbled striking the left anterior chest against a metal casing. On making port, medical attention was sought, and a tight adhesive strapping was applied by a local physician. Because of persisting pain and discomfort, the patient was unable to continue on duty, and 1 week later reported to us still complaining of pain. The area was infiltrated in the manner described above. Immediate and complete relief followed, and the patient was returned to duty at once. X-rays of the chest were negative. The other five cases were of a similar nature and differed only in that the infiltration was done promptly after the injury.

There were five cases of back injury, two of which were classified as sacro-iliac strain and three as lumbosacral strain. The results in these cases were as uniformly successful as in the instances of chest injuries. One case demonstrates the interesting point that despite a long elapsed time between injury and treatment, successful results still are possible with this method of treatment. J. W. M., seaman, first class, suffered an acute low-back strain following a fall in February 1942. He reported to us on April 30, 1942, complaining of per-

sisting pain in the left lower back with radiation down the posterior aspect of the left thigh. Localized tenderness was noted over the left sacro-iliac joint. X-rays of the pelvis and lumbosacral spine were negative. The left sacro-iliac area was infiltrated with 2 percent procaine hydrochloride. Immediate relief of pain was noted and it became possible for the patient to move his back and leg freely with no discomfort for the first time in two months. He was returned to duty at once, and has suffered no recurrence of pain since then.

Nineteen ankle injuries were treated. All cases were infiltrated in the manner described above, and except for certain instances which shall be discussed separately, immediate and completely satisfactory results were obtained. Two cases, L. D. N., private, first class, U. S. M. C., and H. L. B., apprentice seaman, U. S. N., were afforded temporary relief after infiltration. Each proved subsequently to have a fracture of the right navicular, and they were treated accordingly. On March 30, 1942, A. H., lieutenant commander, U. S. N., sustained a simple sprain of the right ankle. This was infiltrated in the usual manner. The pain and discomfort were relieved, and he was able to continue on duty with no loss of time. On June 18, 1942, however, he sustained a severe sprain to the left ankle, and subsequently walked about on it with difficulty for several hours. When finally seen the ankle was markedly swollen and exquisitely tender. The areas about the internal and external malleolus were infiltrated with 10 cc. of procaine hydrochloride with no relief of pain. Subsequent examination showed that the infiltrated areas were relatively free of pain, but the anterior and posterior aspects of the joint still remained painful and tender. Further infiltration was not permitted, and treatment was then continued along conventional lines.

In two cases, J. P. and D. F., seamen, first class, a second infiltration was necessary because of recurrence of pain on the day following the initial treatment. In both instances complete and permanent relief followed the second infiltration, making it possible for both to return to duty.

DISCUSSION

The subject of this report and the results of this method of treatment require no lengthy discussion. The technic is simple, and the materials necessary are few and easily available. The value of a rapid return of normal function of injured parts with consequent immediate availability of the patient for full duty status is clear. Of particular interest is the type of case which may be most successfully treated. Simple back injuries, ankle sprains, contusions of the chest, and as may be seen from the literature, fractured ribs, are probably particularly suitable for treatment by infiltration with procaine hydrochloride. In regard to ankle sprains, probably the simple uncomplicated sprain is most desirable for treatment, and there seems

to be no reason to doubt that in properly selected cases the only reasons for unsuccessful treatment are inadequate infiltration and sensitivity to procaine hydrochloride. In the case of A. H., because further treatment was not possible, we are unfortunately not able to decide whether or not treatment was inadequate, although it should be pointed out that 3 days after the infiltration he was able to return to duty without the assistance of either cane or crutches. This is considered a relatively short period for a severely sprained ankle.

SUMMARY AND CONCLUSION

A report of the results of the treatment of 30 cases of chest contusions, back injuries and ankle sprains by local infiltration with 2 percent procaine hydrochloride is given.

The reduction of the number of sick days in this type of injury, and the relatively simple means by which it may be accomplished makes this a desirable and valuable method of treatment.

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THE RECOGNITION OF EARLY PARKINSONISM¹

By WRENSHALL A. OLIVER, Lieutenant, Medical Corps, United States Naval Reserve

Parkinson's syndrome (paralysis agitans) is that train of signs and symptoms due to disease of the extrapyramidal system, the chief

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cell mass of which is known as the basal ganglia. The neurophysiological mechanisms producing the clinical picture are not well understood, current theory holding that there exists normally an antagonistic relationship between the pyramidal and extrapyramidal systems which is disturbed, with consequent release of abnormal pyramidal tract activity. Certain instances of unilateral parkinsonism in which the pyramidal tract has been severed high in the cervical cord with marked relief of symptoms (one case of which has been observed by this writer) seem to lend support to this view.

At any rate, the disease process is situated principally in the basal ganglia, and consists of degenerative changes which may be consequent upon either senile arteriosclerotic pathology or upon postencephalitic sequelae. There are thus two types of parkinsonism, the senile and the postencephalitic. Writers in neurological journals are fond of expanding on minor clinical distinctions between these two types, but to all intents and purposes they are the same; the chief differences being the etiology, the age group affected, and the amount of response to palliative therapy.

Two well-known schools of thought exist as to the pathological changes in the basal ganglia following epidemic encephalitis, one holding that the virus is actually harbored in the brain tissues for long periods of time, producing its damage by chronic inflammation or by reactivation, the other maintaining that the changes are entirely degenerative in nature, occurring in tissue which was devitalized in the acute stages of the disease. The weight of evidence at present is with the latter view unfortunately, for if the former were the case some hope of arresting the disease by chemotherapy might exist.

In the naval service one is little concerned with senile parkinsonism, but the postencephalitic type is a disease of a younger age group and is not infrequently encountered. The latent period between the acute infection and the development of sequelae is exceedingly variable. I have seen parkinsonism develop within 1 month following acute encephalitis, while on the other hand we are still seeing cases of beginning disability in individuals who give an unquestionable history of having had the disease during the epidemic of 1919. It will be seen, therefore, that cases may be encountered at any time or any place. Nor is it unlikely that in circumstances which exist at present, with crowding of populations and, particularly, with widespread movements of large numbers of men, we may see epidemic encephalitis again in devastating quantity.

As Parkinson's syndrome is a disabling, and in its beginnings a subtly progressive disorder, it is thought worth while to point out some of its early manifestations and means of recognizing them. First, it is to be remembered that the syndrome is entirely a motor one, consisting of increased muscle tone together with the character-

istic tremor, and never involving the reflexes or the sensory tracts. In the late stages one may encounter sensory symptoms, but these are due to mechanical interference with the peripheral nerves. Second, it should be pointed out that the disease is frequently unilateral, or even limited to one extremity, particularly in its beginning stages. In fact, if careful histories are taken it will be seen that a large majority of the cases begin in this manner. Third, there are other post-encephalitic sequelae which, while not due to basal ganglion disease, sometimes accompany it, and should be considered in this connection. These are principally ocular manifestations due to lesions in neighboring portions of the brain and brain stem. Torsion spasms, narcolepsy, cataplexy, and certain other phenomena are not infrequently seen following encephalitis, but seldom accompany the extrapyramidal syndrome. Mental disorders and personality changes, while a frequent aftermath of encephalitis in children, are seldom seen in adults.

The earliest manifestations, therefore, may be seen in various readily observed muscular movements, one of which is the semivoluntary pendular movement of the arms in walking. A loss of arm-swinging, particularly on one side, is highly suspicious as evidence of increased muscle tonus. An unaccountable slowing of the finer skilled movements of the fingers as in typing, piano playing, tying shoelaces, or buttoning the clothes, is a frequent complaint in early cases. The typical "parkinsonian mask" and monotonous speech produced by rigidity of the facial and laryngeal musculature are difficult to detect in their beginnings, but may be noted by friends and relatives of the patient. Perhaps the most typical feature of parkinsonism is the tremor, and if certain characteristics are kept in mind it can hardly be mistaken for anything else. It is above all rhythmic in nature, and relatively slow (usually about 4 cycles per second) which readily distinguishes it from the fine rapid tremor of hyperthyroidism or increased nervous tension, and from the coarse irregular tremors of alcoholism and muscular weaknesses of various origins. Furthermore it characteristically ceases for a moment or two on intended effort (for example, in reaching out to grasp an object) which is, of course, in direct contradistinction to the intentional tremor of multiple sclerosis or disease of certain portions of the cerebellum. The tremor increases with effort or under mental tension (after the initial inhibitory phase) and decreases on relaxation and mental distraction, a fact which occasionally leads to the victim being falsely accused of malingering or of being a psychoneurotic. The tremor usually appears first in the fingers, the neck muscles, or the muscles of flexion and extension of the foot, and may best be observed by watching for a period of time the extended hands, or the feet with the heels slightly raised from the floor as the subject is in the sitting

position. Less commonly the tremor appears early in the muscles of mastication, the tongue, or the eyelids.

An exceedingly common postencephalitic sign accompanying parkinsonism (though, as has previously been noted, not anatomically a part of it) is a paralysis of convergence of the eyes. This will usually result in diplopia at distances under 10 inches from the eyes. A less frequent phenomenon in the same category is the so-called oculogyric crisis, a bizarre and distressing occurrence in which the eyes roll upward in strong and uncontrollable spasm, in periods lasting from a few seconds to an hour or so. Again, this should not be mistaken for a functional disturbance.

While it is not within the scope of this paper to discuss the treatment of Parkinson's syndrome, it may be stressed here that once having been recognized, there are few diseases in the neurological category in which so much relief can be given by palliative therapy. Many of these patients can be maintained in comparative comfort for years by the use of the atropine-hyoscine-belladonna-stramonium group of drugs.

THE USE OF THE RED BLOOD CELL AGGLUTINATION TEST IN THE STUDY OF INFLUENZA¹

By the Personnel² of Naval Laboratory Research Unit No. 1, United States Naval Reserve, University of California, Berkeley, Calif.

Although the phenomenon of the agglutination of chick-embryo red blood cells in contact with influenza infected allantoic fluids had undoubtedly been observed many times before, Hirst (1) was the first to investigate its cause and its relationship to the virus infection of the egg. By adsorption and centrifugation experiments he showed the correlation between the agglutination titer and virus content of infected egg fluids and mouse lung suspensions. Hirst also pointed out that specific immune serum (PR-8) would inhibit the agglutination of the cells by the virus.

During the period of investigation of the phenomenon at this laboratory other papers on the subject have appeared. McClelland and Hare (2) further studied the reaction and suggested a micro test

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² The Unit Personnel consists of: Commander A. P. Krueger, Medical Corps, Officer-in-Charge; Lieutenant L. E. Rosenberg, Hospital Corps; Lieutenant N. S. West, Hospital Corps; Lieutenant, junior grade, J. W. Hope, Medical Corps; Lieutenant, junior grade, A. S. Broune, Hospital Corps; Lieutenant, junior grade, O. J. Golub, Hospital Corps; Ensign J. R. Mathews, Hospital Corps; and Ensign H. M. S. Watkins, Hospital Corps, all of the United States Naval Reserve; Chief Pharmacist E. B. Mansfield, United States Navy; and Chief Pharmacist's Mate I. L. Schechmeister; Pharmacist's Mate, first class, W. L. Axelrod; Pharmacist's Mate, first class, E. R. Chisholm; Pharmacist's Mate, first class, G. B. Saviers; Pharmacist's Mate, second class, C. R. Webb, Jr.; Pharmacist's Mate, second class, H. R. Burkhead; and Pharmacist's Mate, third class, J. A. Gray, all of the United States Naval Reserve.

for the titration of sera which showed some, but not complete, correlation with neutralization tests run on the same sera. This test was conducted by mixing equal amounts of serum dilutions with a constant amount of infected allantoic fluid, after which chick cells were added and the mixtures observed on a glass plate under the microscope. That virus concentration was selected which gave a plus-minus agglutination at a dilution of 1:32 and none at all at 1:64.

In a more comprehensive investigation, Hirst (3) demonstrated the rough correlation existing between agglutinating activity and mouse lethal titers of both egg and mouse lung virus preparations. In running agglutination-inhibition tests on sera it was pointed out that there exists in many normal sera a slight titer of inhibiting substances. After experimenting with the use of varying concentrations of chicken red cells in the system, Hirst decided that a final concentration of 1-percent cells was by far the most satisfactory for ease in reading his tests. From the results of inhibition tests on series of acute and convalescent sera and pre- and post-immunization sera it was concluded that the agglutination test "gives qualitative data regarding influenza antibodies which are similar to the information obtained on the same sera by means of the neutralization test."

Hirst, Rickard, Whitman, and Horsfall (4) have recently published results on a relatively large series of human sera titrated by the agglutination-inhibition method as recommended by Hirst (3). Postvaccination and postinfection mean titers were compared and it was found that both the mean antibody levels and distribution of titers were similar.

Investigations were undertaken in this laboratory in an effort to supplement or replace the expensive and time-consuming mouse titration and neutralization tests with an *in vitro* method which would eliminate biological variation. The need of a satisfactory *in vitro* method for the laboratory study of the antigenic structure of influenza viruses as well as for use in rapid diagnosis is apparent. It is the purpose of this paper to present the results of experimentation directed toward this end.

MATERIALS AND METHODS

Viruses.—Mouse lung or egg fluid preparations of the PR-8, WS, Philadelphia, and Lee strains of influenza viruses were employed in the tests. All suspensions were kept in a CO₂ ice chest when not in actual use. Mouse titrations and neutralization tests were performed, using the quantitative micro-pipette (5) for intranasal inoculations. Fifty percent mortality end-points and 50 percent maximum score end-points were calculated according to the method of Reed and Muench (6). One thousand 50 percent MLD's were used in the PR-8 neutralization tests and one hundred MLD's in the Lee neutralization tests.

Sera.—Human sera were obtained from naval personnel before and two weeks after simultaneous administration of the complex vaccine of Horsfall et al (7) and a type B formalinized virus vaccine (Lee) produced jointly by the staff members of the U. S. Naval Laboratory Research Unit No. 1 and the California State Department of Public Health, Influenza Research Laboratory (8). Rabbit sera were produced by intraperitoneal inoculation of active mouse lung or egg fluid viruses. Horse immune serum was produced by subcutaneous inoculation of repeated doses of PR-8 and Lee mouse lung viruses.

Blood cells.—In the preliminary work, the red blood cells from 15- to 18-day-old chick embryos were used. Normal embryos were opened over the air sac and the vessels ruptured into the allantoic fluid. After drawing off the bloody fluid the cells were centrifuged down, washed twice and resuspended in physiological saline solution. When adult chicken red blood cells were employed, the blood was collected in flasks containing sodium citrate, filtered through two layers of gauze, washed three times and resuspended to the desired concentration in saline. Normal guinea pig erythrocytes were found to be unsuitable for this test as nonspecific clumping invariably occurred.

Due to the difficulties in handling and obtaining chicken cells, and the desire to devise a procedure for possible use in naval laboratories, they were supplanted by human red blood cells which were always readily available. Although chicken cells titrated slightly higher than human cells in agglutination tests on viruses, the availability and ease of handling human cells warranted their use, and results with them have proved very satisfactory.

Obviously, only red blood cells taken from type "0" individuals are suitable for this technic when used in the presence of human sera, due to the natural incompatibility of certain types of human cells and sera. In a preliminary experiment with a large series of blood samples taken from normal type "0" individuals of the naval personnel, titrations were set up to determine the possible presence of significant variations in the results due to the red blood cells themselves. No individual idiosyncracies or interferences were found to exist with the red blood cells taken at random from the type "0" group tested.

The blood was defibrinated with glass beads and filtered through two layers of gauze to remove the clumps and fibrin. The cells thus obtained were washed twice in saline, packed in a graduated tube by centrifuging at 2500 RPM for 20 minutes and finally were resuspended in physiological saline solution to make a 0.75 percent suspension. The red cell count on these suspensions was 80,000 to 90,000 per cm. Unwashed cells were kept up to 5 days in the refrigerator and samples removed for the day's work.

EXPERIMENTAL

Since the approach to this problem was in the direction of evolving a simple test as a substitute for animal titrations, the standard technic for such serological tests was first followed, i. e., a constant amount of virus was added to increasing dilutions of serum and a serum dilution titer determined. In its general method the test was the same as that reported by McClelland and Hare, and by Hirst.

The virus and serum dilutions are recorded in this paper in terms of initial rather than final dilutions.

PLATE 11



BOTTOMS OF TUBES SHOWING THE PATTERNS OF THE RED BLOOD CELLS UPON WHICH THE RECORDED DEGREES OF AGGLUTINATION ARE BASED.

Preliminary titration of viruses.—Prior to the actual test, both mouse lung viruses and the allantoic fluid viruses were titrated for their agglutinating activity. The technic used was as follows: Beginning with either a 10 percent mouse lung suspension or undiluted allantoic fluid virus, twofold dilutions from 1:10 to 1:2560 were made in physiological saline. To 0.5 ml. of each dilution was added 0.5 ml. of a 1:100 dilution of normal rabbit serum in saline. The serum was inactivated for 30 minutes at 56° C. before it was diluted. The tubes were thoroughly shaken and to each was added 0.1 ml. of a 0.75 percent suspension of human type "O" red blood cells. The tubes were again shaken and allowed to stand from 1 to 2 hours at room temperature. They were reshaken and placed in the refrigerator overnight. (This procedure definitely gave more clear-cut, readable results than when the tubes were read the same day.) Agglutination was observed against a background of fluorescent light while looking almost directly up at the bottoms of the tubes. The degree of agglutination was recorded as + + + +, + + +, + +, +, ±, or negative, depending upon the pattern of the cells settled in the bottom of the tube. (See plate 11.) The best angle of observation is easily determined after a little experience.

As Hirst has previously reported, the agglutination titers did not always closely correlate with the MLD titers of the virus preparations. However, the application of this test to egg fluids has proved of considerable value in the saving of time and mice. The presence or

absence of the limiting concentration of virus in experimental egg passages is determined by agglutination titrations before running routine mouse titrations. When egg fluids show little or no agglutinating power, they have proved to have a low mouse lethal titer or be entirely innocuous. In confirmation of Hirst's work on this phase of the problem, it has not been possible for us to predict accurately by agglutination titrations the mouse lethal titers of egg viruses. The limiting concentration of virus detectable by this method seems to fall between $10^{-1.5}$ and 10^{-3} as calculated by 50 percent mortality end points. Differences in adaptability of the egg viruses to mice is no doubt partly responsible for this variation.

The optimum concentration of red blood cells to be used was determined by varying the cell concentrations from 0.5 percent to 10 percent. A 0.75 percent suspension containing 80,000 to 90,000 red blood cells per cm. was found to give the most easily readable pattern of cells in the bottoms of the tubes. Higher concentrations of cells not only completely masked the agglutination in the higher virus dilutions, but made the grading of the agglutinated tubes more difficult.

It has been noticed in virus titrations in which no serum was used, the 0.1 ml. of blood cells being added directly to virus diluted in saline, that the cells did not settle out cleanly into a clear-cut button at the bottom of the tube. There appeared to be an adhesive force acting, possibly due to the charge on the glass, which caused the formation of what we have called a "film" of cells around the edge of the packed area. This difficulty was obviated by the use of the 1:100 serum dilution. For ordinary virus titrations normal rabbit serum was substituted for the test serum of the inhibition titrations. The inclusion of normal rabbit serum in the virus titrations produced a pattern of agglutinations identical with that observed in the inhibition series.

Serum dilution titration.—The technic of the serum dilution method of conducting the agglutination-inhibition test is as follows: Sera from rabbits which had received intraperitoneal inoculations of a single strain of active mouse lung or egg fluid virus were inactivated for 30 minutes at 56° C. Subsequently twofold dilutions from 1:5 to 1:640 were made in physiological saline. To 0.5 ml. of each dilution was added 0.5 ml. of a constant amount of virus suspension. Considering the 10 percent mouse lung suspension as undiluted, the virus dilutions used were PR-8 1:40, WS 1:40, Philadelphia 1:40, and Lee 1:20; all were found to be well within the range of agglutinating activity. The Lee strain of virus was used in higher concentration than the type A strains, since it consistently showed a lower titer and lesser degree of agglutinating power. The tubes were thoroughly shaken, placed in the 37° C. water bath for 20 minutes, and to each tube was added 0.1 ml. of a 0.75 percent saline suspension of

human red blood cells. The incubation period of 20 minutes was included to simulate as closely as possible the procedure of the neutralization test practiced in this laboratory, although it has since been shown by other investigators that the combination of the virus and antibody is almost immediate, whether at room temperature or at 37° C.

Upon running agglutination inhibition titrations on a number of immune rabbit sera by the serum dilution method it was noted that with several of the sera agglutination occurred in tubes containing high concentrations of the homologous immune serum, whereas it was expected that the inhibition would be most strong in these tubes. It was decided to investigate this zone phenomenon by determining more fully the relationship between serum concentration and virus concentration.

Several normal rabbit sera were titrated against serial dilutions of virus to determine the lowest dilution of serum in which the inhibitory action and possible agglutinating action of normal serum would fail to appear. In tests using mouse lung agglutinating virus the serum dilution of 1:100 was chosen as that which was sufficiently high to be beyond the range of the nonspecific inhibitory action of certain normal sera.

When several immune rabbit sera were similarly titrated against serial virus dilutions it was found that some produced agglutination, even in the absence of virus, in as high a dilution as 1:40. This agglutination of human cells by rabbit serum in high concentration is probably due to normal agglutinins for human cells found in a definite percentage of rabbits according to Stuart, Sawin, Wheeler, and Battey (9). These authors, in a series of tests on 422 rabbits, found 19 percent of the group to contain agglutinins for "O" type human cells, with an average titer of 1:30. In rabbits over 5 months old the titers in no case were over 1:40. Consequently the 1:100 dilution is considered to be the optimum for the inhibition test employing the virus dilution method, as it not only eliminates interference from nonspecific agglutination of the cells by rabbit sera, but effectively retains the specific antibody action.

TABLE 1.—*Titration of normal rabbit serum against serial dilutions of PR-8 allantoic fluid virus*

Serum dilution	Virus dilution								Control
	10	20	40	80	160	320	640	1280	
1:10.....	++++	++++	++++	++++	+++	+	+	±	—
1:20.....	++++	++++	++++	++++	++++	++	±	±	—
1:40.....	++++	++++	++++	++++	++++	++++	+++	+	—
1:80.....	++++	++++	++++	++++	++++	++++	++++	+++	—
1:100.....	++++	++++	++++	++++	++++	++++	++++	+++	—
1:160.....	++++	++++	++++	++++	++++	++++	++++	+++	—
1:320.....	++++	++++	++++	++++	++++	++++	++++	+++	—
1:640.....	++++	++++	++++	++++	++++	++++	++++	+++	—

Table 1 represents one of the titrations of a normal rabbit serum against different concentrations of a PR-8 allantoic fluid virus. This serum was one which did not cause agglutination of the cells per se, so that the normal inhibitory action is apparent. The results show the nonspecific inhibitory action of this normal serum to extend through the 1:40 dilution against the higher virus dilutions. The 1:100 serum dilution was consistently found to be beyond the normal inhibitory interference.

Table 2 shows the results of an agglutination-inhibition titration using the same procedure as in table 1, but employing a PR-8 mouse lung virus against an homologous immune rabbit serum. This serum was one which showed the highest titer of agglutination of the red cells by serum alone. There was strong agglutination in the control tubes (serum dilution+cells) through the 1:40 dilution of serum, slight agglutination at 1:80, and none at all at 1:100 or higher. Beyond the 1:320 dilution of serum it becomes increasingly difficult to read the negative tubes due to the film formation around the packed cells.

Thus it was considered that a virus dilution titration using a constant (1:100 dilution) amount of serum would be a most satisfactory method both for the agglutination titration of viruses and the antibody titration of sera. This method can be used with experimental animal sera for the study of antigenic relationships as well as with human sera for the detection of inhibition differences. The serum dilution method and the virus dilution method both reveal the same action in two different ways; the former measures to what degree a serum may be diluted and still combine with a given amount of virus, while the latter measures the quantity of virus with which a given dilution of serum can unite.

Virus dilution titration.—A number of immune rabbit sera were tested against the PR-8, WS, Philadelphia, and Lee viruses by titrating a 1:100 dilution of serum against increasing dilutions of virus. A serum-saline control series, using 1:100 normal rabbit serum was run with each virus. Each series was compared with the serum-saline control series to determine the degree of immune serum inhibition, and end-points were considered as a one-plus reading. Titers were read in terms of the fold difference in titer between the test serum and the normal serum control series. For example, if a serum inhibited agglutination beyond a virus dilution of 1:20 while the normal serum series agglutinated out to a one plus or more in the 1:640 dilution, the titer was read as 32. This indicates that the 1:100 dilution of immune serum inhibited 32 times as much virus as a comparable dilution of a normal serum.

TABLE 2.—*Titration of PR-8 immune serum against serial dilutions of PR-8 mouse lung virus*

Serum dilution	Virus dilution									
	10	20	40	80	160	320	640	1280	2560	5120
1:10	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:20	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:40	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:80	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:100	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:160	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:320	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:640	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:1280	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:2560	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:5120	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
1:10,240	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++

NOTE: "r" indicates film formation in these tubes.

TABLE 3.—Strain specificity of influenza viruses demonstrated by virus-dilution method of the agglutination-inhibition test. Four viruses titrated against 1:100 dilution of sera

Sera (1:100 dil.)	Virus	Dilution of virus							Inhib. titer
		1:10	1:20	1:40	1:80	1:160	1:320	1:640	Control
PR-8 rabbit No. 1	PR-8	+	±	—	—	—	—	—	—
	Lee	+++	+++	+++	+++	+++	+++	+++	64
	Phil	+++	+++	+++	+++	+++	+++	+++	0
PR-8 rabbit No. 2	WS	+++	+++	+++	+++	+++	+++	+++	32
	PR-8	+++	+	±	—	—	—	—	—
	Lee	+++	+++	+++	+++	+++	+++	+++	0
Lee rabbit No. 1	Phil	+++	+++	+++	+++	+++	+++	+++	32
	WS	+++	+++	+++	+++	+++	+++	+++	0
	PR-8	+++	+++	+++	+++	+++	+++	+++	0
Lee rabbit No. 2	Lee	+	—	—	—	—	—	—	—
	Phil	+++	+++	+++	+++	+++	+++	+++	32
	WS	+++	+++	+++	+++	+++	+++	+++	0
Philadelphia rabbit No. 1	PR-8	±	—	—	—	—	—	—	—
	Lee	+++	+++	+++	+++	+++	+++	+++	0
	Phil	+++	+++	+++	+++	+++	+++	+++	32
Philadelphia rabbit No. 2	WS	+++	+++	+++	+++	+++	+++	+++	0
	PR-8	+++	+	±	—	—	—	—	—
	Lee	+++	+++	+++	+++	+++	+++	+++	16
WS rabbit No. 1	Phil	+++	+++	+++	+++	+++	+++	+++	0
	WS	+++	+++	+++	+++	+++	+++	+++	32
	PR-8	+++	+++	+++	+++	+++	+++	+++	2
WS rabbit No. 2	Lee	+++	+++	+++	+++	+++	+++	+++	4
	Phil	+++	+++	+++	+++	+++	+++	+++	0
	WS	+++	+++	+++	+++	+++	+++	+++	16
	PR-8	+++	+++	+++	+++	+++	+++	+++	4
	Lee	+++	+++	+++	+++	+++	+++	+++	0
	Phil	+++	+++	+++	+++	+++	+++	+++	0
	WS	+++	+++	+++	+++	+++	+++	+++	16
	PR-8	+++	+++	+++	+++	+++	+++	+++	4
	Lee	+++	+++	+++	+++	+++	+++	+++	0
	Phil	+++	+++	+++	+++	+++	+++	+++	0
	WS	+++	+++	+++	+++	+++	+++	+++	32
	PR-8	+++	+++	+++	+++	+++	+++	+++	2
	Lee	+++	+++	+++	+++	+++	+++	+++	0
	Phil	+++	+++	+++	+++	+++	+++	+++	0
	WS	+++	+++	+++	+++	+++	+++	+++	0
	PR-8	+++	+++	+++	+++	+++	+++	+++	64
	Lee	+++	+++	+++	+++	+++	+++	+++	0
	Phil	+++	+++	+++	+++	+++	+++	+++	0
	WS	+++	+++	+++	+++	+++	+++	+++	32

The strain specificity of the reaction was demonstrated by typical results such as those shown in table 3. Also included in this table are a swine virus immune rabbit serum, a San Francisco virus immune rabbit serum,³ and preimmunization and postimmunization serum samples from a horse which received five subcutaneous inoculations of mixed PR-8 and Lee mouse lung viruses. Upon examination of these results and comparison of each series with the serum-saline control, a decided strain specificity of the reaction is evident. There is no inhibition of agglutination of any of the A strains studied by any B antisera, and vice versa, no cross reaction by any of the A sera with the B virus. However, within the A group, as might be expected, there appears definite crossing over. The homologous serum-virus mixtures always show the greatest inhibition, often resulting in a complete inhibition in as high a concentration of virus as the 1:10 dilution. PR-8 antisera show considerable crossing over with the Philadelphia virus and but slight cross reaction with the WS strain. The Philadelphia antisera partially inhibit the action of the PR-8 virus, but show little reaction with the WS strain. The WS antisera exhibit slight inhibition of agglutination with both the PR-8 and Philadelphia strains of virus. Neither the swine immune rabbit serum nor the San Francisco virus immune rabbit serum possessed agglutination-inhibition antibodies against any of the virus strains tested. The immune horse serum reveals a considerable titer against both the PR-8 and Lee viruses, a partial inhibition of the Philadelphia virus, and very slight reduction of the WS virus agglutination capacity.

Since no specimens of acute and convalescent human sera were available, the only human samples tested were those from naval personnel vaccinated with the complex vaccine produced by the Rockefeller Institute and a type B (Lee) vaccine produced jointly by the United States Naval Laboratory Research Unit No. 1 and the California State Department of Health, Influenza Research Laboratory (8). A number of these blood sera which had been titrated by the neutralization test against the PR-8 and Lee viruses subsequently were titrated for agglutination-inhibition antibodies. Since only a few of this series had shown the significant fourfold rise in mouse-neutralizing antibodies, the results of the agglutination-inhibition tests could only show slight, doubtfully significant, differences between the pre- and post-immunization samples. However, the trend of the change consistently followed the neutralizing titers and those few sera which did show considerable increases in neutralizing antibodies also showed the greatest increases in inhibition titers. It will be of interest to determine more fully the correlation of this test with

³ Obtained through the courtesy of Dr. Monroe D. Eaton.

the mouse-neutralization test so that its real value as a simple substitute may be assessed.

Experiments have been conducted to compare the sensitivity of the agglutination technic used in this laboratory with that suggested by Hirst. It must be remembered that the results of the agglutination-inhibition and virus-titration experiments in the work of Hirst are reported in terms of final, rather than initial, virus concentrations. Therefore, for comparative purposes, the end-points recorded in this paper must be approximately doubled to obtain figures for final concentrations. Titrations run on several viruses, both mouse lung and egg, have consistently shown at least a fourfold higher dilution end-point of agglutination when tested by the technic herein described. This is evidence that considerable masking of agglutination takes place when relatively heavy concentrations of blood cells are used.

A somewhat analogous finding has been reported by Lund (10) in experiments on the optimum concentration of erythrocytes in the iso-agglutination reaction. He states that increasing sensitivity results from the use of diminishing final concentrations of erythrocytes in the reaction, and that the concentrations of red blood cells usually advocated are excessive and insensitive for detecting traces of agglutinin. Final concentrations of 0.0625 percent were found to be eight times as sensitive as the usual 0.5–1.0 percent suspensions. Although the iso-agglutination reaction is concerned with the clumping of red cells by antibodies, whereas we are concerned with an agglutination of the cells by virus, the quantitative relationship of the two reactants is probably the determining factor in achieving a sensitive system in both cases.

DISCUSSION

The neutralization test has furnished the most satisfactory basis for quantitative estimation of influenzal antibodies since the discovery of the virus etiology of the disease (11). Although recent work (12) (13) has justified the conclusion that a high neutralization titer and resistance to specific influenza infection generally go hand in hand, exceptions do occur and individuals possessing high neutralizing titers nevertheless have acquired the infection while others whose titers were low have not done so. The view has been advanced that immunity to influenza involves factors other than humoral antibodies (14), the precise nature of these factors being as yet uncertain.

Even with this limitation, the neutralization test has found wide application in influenza research not only as a useful quantitative device for purely laboratory experiments but also as a means of elucidating the none-too-clear epidemiology of the disease. This is

true despite the fact that the test is cumbersome as a diagnostic aid, requiring a period of at least a month after the onset of infection for completion and involving considerable expense.

In comparison with the neutralization test complement-fixation has not been as satisfactory, first, because the results are frequently difficult to duplicate, and second, because the correlation of complement-fixation titers with neutralization titers is not always positive.

When a basic analysis of the fundamental facts involved in immunity to influenza is attempted one is immediately confronted with the probability that the determination of humoral titers is an imperfect measuring stick. We are not in a position to state whether the humoral response is primary or whether it is a secondary reaction concomitant with some as yet unidentified cellular phenomenon. By the same token, it should be kept in mind that the demonstration of neutralizing antibodies and complement-fixing antibodies does not necessarily exclude the possibility that other antibodies similarly linked to the immune response may exist. It may well be that the substance responsible for agglutination-inhibition is such an antibody and that its presence or absence has definite immunological significance. After all, antibodies in general are evoked by cellular reaction to antigenic stimuli and it has been shown that the influenza viruses possess definite antigenic complexities. In view of this it is not altogether surprising that it is difficult to demonstrate complete correlation between the neutralization, complement-fixation, and agglutination-inhibition tests. Future work on a large scale may demonstrate as close a correlation between the agglutination-inhibition titers and resistance to infection as has been observed with neutralization titers and specific immunity.

It is well to point out also that due to the marked specificity of the inhibition test, even within the type A group of viruses, true titers on sera from immunized animals can be obtained only when tested against homologous viruses. This holds, of course, with the neutralization test as well, but probably not to such a high degree. A human serum sample from a patient convalescent from an infection with a type A virus with antigenic structure of the WS strain might show little increase in titer were the inhibition test conducted only against the commonly used PR-8 strain. However, according to Horsfall and Rickard (15) "the increased concentration of neutralizing antibodies against influenza A virus in human serum which occur after influenza A do not differentiate between antigenically different strains of this virus or swine influenza virus but instead appear to possess equal reactivity against these agents." This may also be true with regard to agglutination-inhibition antibodies in human convalescent serum; if not, the simplicity of running inhibition titrations

allows the inclusion in the test of as many different strains as are available, so that early in an epidemic the predominating strains could soon be determined, whereas obtaining the same information by means of the neutralization test would involve a heavy burden of time and expense.

Our investigations have been somewhat handicapped by the lack of influenza convalescent sera upon which to experiment. A definite comparison between the virus dilution method of conducting the agglutination-inhibition test and the mouse neutralization test must therefore wait until such a series is run. We would be anxious to see the results of such a comparison from a laboratory where such sera are available.

The virus dilution method as presented here offers several advantages, in our opinion, over other microscopic or macroscopic tests previously published. The use of human cells in the reaction facilitates the matter of obtaining this reagent in laboratories where chickens or chick embryos are not readily available. This would be especially true of naval laboratories, whose interest we naturally have first in mind.

The low concentration of red cells employed in the test results in a definitely greater sensitivity of the reaction, and to our minds, a more easily readable tube. Thus, smaller amounts of virus are detectable in virus titrations, and smaller amounts of uncombined virus are revealed in inhibition titrations.

No critical time interval between the setting up and the reading of the test need be prescribed, as the tubes may be read any time during the next day.

The use of only one serum dilution, 1:100, not only simplifies the procedure of the inhibition test, especially when running a large group of sera, but also eliminates interference due to the inhibitory action of normal sera. When using the inhibition test as an experimental tool in the laboratory, the 1:100 serum dilution also precludes the possibility of agglutination of cells due to nonspecific factors present in the serum of some animals.

SUMMARY

A macroscopic virus dilution method of measuring agglutination-inhibition antibodies to influenza has been described. Human red blood cells of "0" type are used instead of the chicken cells customarily employed.

The procedure may be adapted to the direct determination of influenza virus and rough estimates of virus concentrations can be

made by its use. Normal rabbit serum in the standard 1:100 dilution is included in such virus titrations.

The test is sufficiently sensitive and specific to be used in laboratory studies on antigenic structure of influenza viruses.

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PSYCHIATRIC ASPECTS OF MILITARY DISABILITIES ¹

By L. R. GOWAN, Lieutenant Commander, Medical Corps, United States Naval Reserve

The psychiatric aspects of military disabilities present a serious problem to those responsible for maintaining the fighting strength of the Nation. These disabilities include not only conditions, the result of exposure to war, but also those psychiatric conditions which create disabilities that prevent active service participation. The magnitude of the problem can perhaps be best recognized by turning briefly to the experiences of the last war. These experiences forcibly called attention to psychiatry as having made an important contribution to war medicine. This in turn gave great impetus to the growth of psychiatry as a whole.

Psychiatric disabilities of the last war can be tangibly measured by their material costs to the Nation, in pensions, medical care, and maintenance of special institutions for the care of mentally ill. Even this measurement is at best only an estimate. Undoubtedly, thousands of disabilities followed war experiences that have never come to the front to be counted either through the demand for compensation or the necessity of medical care. Nervous and mental disabilities resulting from the last war have cost the Nation approximately \$1,000,000,000; a sum perhaps small in comparison to our present-day standards of spending but, nevertheless, representing in dollars and cents the suffering, unhappiness, and economic loss of manpower of an army in itself. Approximately 20 percent of the total number drawing compensation from the Veterans' Administration are disabled mentally. It has been estimated that the average cost of caring for a mentally disabled serviceman for the duration of his life is close to \$35,000. Up to the present war 55 percent of all beds in military hospitals were occupied by patients with neuropsychiatric disorders.

It is to be hoped that the experiences of the present war in relation to psychiatric disabilities will be to some extent mitigated by an ever-increasing awareness of their importance: First, on the part of selective service boards and recruiting agencies; second, by those actually in command; and third by their medical officers.

Experiences so far in this war indicate that from one-half to two-thirds of those who suffer nervous break-downs are predisposed to such disabilities. In many instances it is only by careful psychiatric

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interpretation that factors pointing to faulty personality developments are discovered. We have observed that many individuals seeking to enter military service cover up and fail to disclose neuro-pathic tendencies—some because of a zeal to serve, others because of pride, and still others because they recognize their deficiencies and hope that military experience will serve as a means of escape. These cases should be screened out during the examination conducted at the point of enlistment.

It might be assumed that mental disease would frequently be used as a means of avoiding service by those attempting to malingering. On the contrary, few malingerers choose mental disease as their method of avoiding service. Mentally healthy malingerers are more likely to try to escape service by other means. A prospective serviceman who would attempt to act a mental or physical disease, would be very likely to continue this method and be a problem requiring considerable time and effort on the part of personnel. Rarely would he be an asset. These should be eliminated before entering service.

There is no place in military life for the so-called "problem" boy or man. Communities have in the past attempted to unload their misfits and socially undesirables by suggesting service in the Army or Navy. Courts have even placed these individuals on probation, provided they enter the service. Although persons with physical defects often better their health by military service, the same cannot be said for those with nervous or mental impairments. Military service does not get rid of these problems, but tends to aggravate them, resulting in more serious and often permanent disabilities. These individuals return to their communities a greater problem than when they left. They do not fit into the military picture. They are frequently recognized as queer and are made fun of. They react badly to discipline and undermine morale. Their activities are often discounted and allowances made for them. This in turn appears as discrimination and morale suffers as a consequence.

Military life should not be painted in terms of glamour, but an honest picture of opportunities for the fulfillment of duty and the development of a high sense of honor should instead be presented. Unfulfilled promises of rapid advancement and high ratings bring disillusionment, resentment, and disappointments, often leading to depression, anxiety, and paranoid feelings. The recognition of this source of discontentment on the part of the officers in command and an earnest attempt to fit the man to the job will go a long way toward the prevention of many psychoneurotic states.

A medical officer who recognizes the importance of the mind in relation to the development of both physical and psychiatric disabling conditions, and who has equipped himself with a working knowledge

of how to deal with them, can prevent minor mental disturbances from becoming serious ones. The suffering of the more severely disabled patient may be alleviated by adequate means of treatment, segregation, and evacuation.

There are several factors involved in the production of psychiatric disabilities among those in active military duty. War brings about many situations that require the individual to make emotional readjustments. Kardiner has put it well when he points out that, "War is an anxiety provoking situation that strips the individual of the protection of peacetime activity and leads to injury of the individual's adaptation." Active military service creates in most instances rather profound social dislocation. It requires adjustment to the group and exposes one to the reactions of the mass. It requires restrictive subjective discipline in order to accept the objective restrictive discipline. War experiences often act as a precipitant for emotional disturbances that under ordinary circumstances are held in solution. The unusual experiences create a saturation of the mental conflicts to the point of crystallization of a psychoneurotic or psychotic reaction. The defensive mechanisms are dissipated, revealing the abnormal background. The safety devices so successfully built up to take care of social adaptation in peacetime are no longer adequate.

The outstanding cause of war neuroses, apart from predisposition, is the unconscious fear of death or disablement; the conscious fear of pain, loss, or uncertainty of what is to occur. Psychoneurotic symptoms persist so long as there is conflict between desire for self-preservation and sense of duty. Conflict leads to repression or inhibition. If inhibition is carried to an abnormal degree it interferes with adaptation. This may lead to a change on the part of the patient in regard to his concept of himself in relation to the outer world. The neurosis is then an attempt to reestablish an adaptation on the basis of the reduced resources. The new behavior manifested by the patient is the result of the individual's effort to adjust himself with inadequate weapons.

Wartime psychiatric disabilities fall into many categories. Complexity and severity determine whether one has to deal with a simple nostalgia or a severe, well defined psychosis. A large majority fall into the classification of psychoneuroses of one type or another. Of these, traumatic neurosis (so-called war neurosis), hysteria, neurasthenia, various anxiety tensional states and situational neuroses make up the bulk of the cases. Patients with underlying constitutional psychopathic states are common and may be subclassified into the inferiority group, the inadequate personalities, and those fundamentally emotionally unstable. Psychopathic personalities are seen

frequently. This group has great difficulty in making adjustments to the demands of military life. They are characterized by aggressiveness, egocentricity, defective judgment, inability to profit by past experiences, unreliability, and irresponsibility. They lack perseverance, and are emotionally unstable with swings of mood, temper, outbursts, and psychotic excitement periods. They are suspicious and frequently paranoid. They are often alcoholic. They make no attempt to adjust to the environment but rather attempt to make the environment over to suit themselves. In this respect they differ from the neurotic individual who considers his environment and attempts some adjustment to it.

Of the major psychoses, schizoid or more fully developed schizophrenic states (*dementia praecox*), are the most commonly seen. Statistically this would be expected since a large majority of military personnel fall within the age limits in which this reaction usually appears. Reactive depressions are frequently seen. Hypomanic and manic states are not prominent. Perhaps the opportunity for varied activity and degrees of excitement act as a safety valve for this group, affording an outlet for their increased psychomotor needs.

Convulsive disorders are frequently seen. Often these appear for the first time shortly after entering the service. Careful history taking may disclose evidence definitely indicating that the condition existed prior to military induction. These cases require complete study, including comprehensive physical examination, special neurological examination, skull x-ray, and complete laboratory study, including blood sugar determination. Where the neurological findings or history are significant, encephalography should be performed.

Mental disturbances associated with organic brain disease are not commonly encountered in military life. The age group that makes up military personnel is much younger than that in which degenerative vascular and other deteriorative processes develop. War wounds do not ordinarily produce mental disturbances, but may contribute to their production by creating pain, fatigue, and general imbalance of physiological processes. The treatment of syphilis has advanced to the point where this disease is rarely seen as the cause of mental illness in military life.

There is a large group of cases to be found on the medical wards of every military hospital who present symptoms of physical diseases that are psychogenic in origin. Visceral activity is ordinarily unconscious. Under emotional stress physiological functions usually silent (such as pulse) often break through to the conscious level. The individual becomes aware of the visceral process (pounding of his heart), and his attention is shifted from the outer environment to his inner self. This leads to anxiety and fear and fixes the atten-

tion of the patient in such a manner as to produce a hypochondriacal state. If this continues, an irreversible disease process may result. This group of patients is best described as suffering from psychosomatic disorders.

Psychosomatic disorders may be classified under several heads:

1. The cardiovascular group, consisting of disordered action of the heart leading to hypertension, extrasystoles, tachycardia, and distressing cardiovascular consciousness.

2. The gastro-intestinal group, including gastric and duodenal ulcers, hyperacidity, pylorospasm, mucous colitis, spastic constipation, and diarrhea.

3. A group of urinary disturbances—these consist of frequency, urgency, and even bed-wetting. These symptoms produce important psychological reactions in that they often lead to a habit of isolation in an attempt to cover up the defect.

4. The "effort syndrome" is a focal neurosis belonging to the psychosomatic group. It consists of a condition in which the patient's energy is not constant, resulting in periods or "attacks" of great weariness with evidence of collapse, faintness, dyspnea, and cardiac distress.

5. A group characterized by marked vasomotor instability. These patients present increased sweating; cold, clammy hands; marked facial blushing; and erythromelalgic features. These features are undoubtedly psychogenic in origin. They may have profound effect on the individual's ability to live with others.

6. Functional tics and tremors. These are neurogenic disorders on a psychosomatic basis.

Psychosomatic problems may be considered from another angle:

1. Those in which the personality disorder resembles a somatic disease in its expression.

2. Those in which somatic disease is present but is not taken into account because of a more prominent coexisting personality disorder.

3. Those in which somatic disease is so prominent that the contributing personality factors are concealed or in the background.

Many psychosomatic states are reversible. Frequently they are the expression of situational neuroses. These patients may be made aware of their problems and acquire insight. They are often able to relate their difficulties and accept guidance, with the result that their symptoms soon disappear.

The following case reports illustrate a few of the types of reactions frequently seen, which are the result of military experiences.

CASE REPORTS

Case 1.—R. L. W., a 17-year-old member of the Marine Corps was admitted to the hospital with a tentative diagnosis of depressed phase of a manic-depressive psychosis. He complained of general nervousness, anxiety, dizziness, and pains in his chest. He was moderately depressed. Mental examination revealed marked anxiety largely relative to his home, difficulties in adjusting to service life, and many somatic complaints with evidence of emotional overflow; i. e., dizziness, headaches, chest pains, etc.

Physically no objective evidence of organic disease was found. Routine laboratory studies gave normal findings.

For the first 2 weeks he was very depressed, desiring to stay in bed, complaining about his eyes, dizziness, headaches, and chest pains. He refused to eat and could not be interested in any ward activities. His physical complaints were repeatedly looked into and he was reassured concerning them. Gradually he began to improve. He appeared rested; became more cheerful; and began to take part in recreational and occupational activities.

Repeated interviews succeeded in giving him insight into his situation and it became apparent that he was suffering from a superficial emotional reaction, rather than a deep-seated personality disturbance. The diagnosis was changed to nostalgia. He was discharged to duty. Contact with this man several weeks later brought forth the report that he had had no return of his trouble, and was carrying out his duties in an efficient manner.

Case 2.—M. F., a seaman second class, was sent to the hospital, because he went over the side of his ship. The family history was essentially negative except for a maternal uncle who had a "nervous breakdown" for a few weeks from which he made a complete recovery.

His early health record was uneventful. He completed eleven grades in school and was considered a good student. He left school to join the Navy under the pressure of his family to learn something and add to the family income.

He described himself as always having been a "nervous, down-cast guy." When he was 15 years old he began to rebel against everyone. He was frequently expelled from school because of talking back. He began to feel careless about himself and did not care what people thought. He was nervous and physically clumsy. He found it difficult to compete with others in school activities and acted disagreeably to show he did not care. After joining the Navy he found himself nervous and unable to learn drills, etc. He lost confidence and again became rebellious. Upon going to sea he became seasick; did his work poorly and at times was so nervous he became confused. He got along poorly with his shipmates. He became sleepless. Many of his activities were thought "queer" by the other men.

He was reduced from seaman first class to second class by the commanding officer because of his general inaptitude. Following this he became very upset, began to drink, stayed up all night, and felt abused. He felt he had to get off the ship and jumped overboard. He swam around until a line was thrown to him.

Mental examination revealed a nervous, tense, excitable young man, unable to relax, clumsy in manner and speech. He was easily flustered, hesitating and uncertain under pressure. He was unhappy over troubles in the Navy. He was overanxious and worried.

He was observed for several weeks and continued to show marked emotional instability. He was unable to control himself whenever under the influence of strong emotional reaction. At times he was openly rebellious, impulsive, and unpredictable. He repeatedly broke rules of the ward.

Psychotherapy was unavailing. The diagnosis of constitutional psychopathic state, emotional instability was made and he was discharged from the naval service.

Case 3.—C. S., a chief water tender, 53 years old, with a normal family history and a normal industrial, social, and educational history, was admitted to the hospital on January 8, 1942, on account of marked nervousness, depression, and anxiety.

His past physical history was negative.

He enlisted in the United States Navy July 1918; transferred to the Reserve in 1919, reenlisted in 1921, and has had continuous service ever since. He was advanced in rating and made a chief petty officer in 1932. He had never required discipline, and had a good record.

He was apparently in excellent physical and mental health up to December 7, 1941. At that time during action with the enemy he became extremely upset, nervous, and worried. Following this, on several occasions, he was found wandering about the ship in an aimless manner. He was sleepless, had profuse night sweats, and became increasingly nervous. He expressed great fear for the ship's safety. He vomited after several meals.

On entrance to the hospital he was very nervous, tense, tremulous, depressed and, at times, slightly confused. He had ideas that his shipmates thought he had "let them down." He was sleepless and constantly weepy.

Aside from his tenseness and tremors and an appearance of marked fatigue from loss of sleep, the physical examination was normal.

He was given sufficient sedation to keep him almost continuously asleep for 48 hours, following which sedation was gradually withdrawn. At the end of a week he was much quieter, less anxious, and able to talk about his problems quite freely. Sedation was discontinued and frequent psychotherapeutic interviews were held. He has made steady improvement so that at the present time he is nearly well. Loud noises, fire drills, and air raid drills no longer annoy him. He is gaining a self-reliant attitude; shows a desire to be given responsibility and soon will be ready to leave the hospital.

Case 4.—This 23-year-old man, derived from a family which included several members whom he describes as "queer," had feelings of being different from his associates prior to his enlistment in the Navy.

For 2 years he had no trouble adjusting to service requirements. Immediately following the Pearl Harbor episode he experienced the sensation of being closely observed in a critical accusing manner by his shipmates. Their gestures, speech, and actions were referable to him and conveyed to him the feeling that he was a coward, that he had let everyone down, and that he was a hated fifth columnist.

Because of his feelings of anxiety and depression, he began to drink heavily, although he had not used alcohol before.

While drinking he experienced vivid auditory hallucinations which paralleled his thoughts, but in some instances referred to matters unfamiliar to him.

He felt puzzled and confused and made great mental effort to grasp what was expected of him and "what it was all about."

Rest and activity resulted in the disappearance of the hallucinations and a lifting of the mood. There occurred a gradual diminution of the puzzled feeling but he persisted in his efforts to think out or ascertain by inquiry some explanation of what he had done that was wrong, of what people thought him guilty, and what he could do to be like other people.

He was transferred to another hospital for more prolonged treatment.

This boy represents a severe war neurosis in a schizoid personality.

A consideration of nervous disabilities in the light of present war methods must necessarily include a description of the reactions of the civilian as well as of the men in the armed service. Gillespie has called attention to the fact that the psychoneuroses among civilians in wartime can be divided into two classes according to their etiology: First, following exposure to danger; second, following dis-

organization of the life of the individual as a result either of conditions in a bombed area, or of evacuation to a strange district. The psychological reactions to bombing in air raids are immediate and remote. The immediate include acute panic with or without disorientation or amnesia, immobility or passive reactions, and direct bodily manifestations of fear such as tremors, etc. The remote reactions are a perpetuation of immediate symptoms or they may develop after a latent period, following rumination. All such reactions occur as a rule only in the predisposed, but are occasionally seen in others after repeated exposure to harrowing experience or after an unusually fearful experience. The terrifying experiences are not usually repressed, but when they are, it is most often because of some self-reproach about misconduct or failure to perform their duty. Previously existing mental conditions can be accentuated by experiences of air raids; however, it is not surprising that some individuals with chronic psychoneurotic conditions have shown symptomatic recovery as the result of living and working under a "blitz."

Some chronic psychoneurotics and psychotics because of their introspective fixations or affective deterioration, are apathetic to the said experience. People who use deeper shelters are more affected by fear of raids than others. As a general rule the more active and busy people are, the less likely they are to show psychoneurotic effects following exposure to raids. Shelter life leads to boredom and general apathy. It has been experienced in England that the more civilians continue to lead a normal day by day existence in spite of the danger around them, the less likely they are to develop mental illness. Some civilians show conditional responses and react with psychoneurotic symptoms to anything that reminds them of air raid experiences.

The United States is profiting by the experiences of our British allies who have learned much relative to the importance of sustaining civilian morale and the method by which it can best be accomplished. Sustaining civilian morale is an important phase of preventive psychiatry.

SUMMARY

1. The psychiatric aspects of military disabilities present a serious problem to those responsible for maintaining the fighting strength of the nation. The magnitude of the problem is evidenced by the fact that as the result of the last World War the United States has spent \$1,000,000,000 in pensions, medical care, and maintenance of special institutions for the care of the mentally ill.

2. Military service is no place for the so-called problem boy. Invariably the demands of adjustment to military life accentuate these problems.

3. Military life should not be painted in terms of glamour but in terms of opportunities for the fulfillment of duty and the development of a high sense of honor.

4. War experiences often act as a precipitant for emotional disturbances that under ordinary circumstances are held in suspension. War neurosis is not a new disease, but merely the appearance of previously existing neurotic tendencies brought to the front and organized into form by exposure to war's demands. From one-half to two-thirds of those suffering mental or nervous disturbances among our armed forces show definite predisposition.

5. Modern warfare with its bombing, blackouts, and "shelter" life produces mental disabilities among civilians as well as combatants. Experiences in England have shown that civilians who carry on their usual daily duties in spite of potential danger, are less likely to suffer mental breakdown than those who seek refuge by evacuating or by leading an underground life.

6. The importance of psychiatric disabilities in military life is being recognized by those at the head of our armed forces as never before. Every effort is being made to exclude them, to prevent them, to alleviate them, and to rehabilitate them.

PSYCHOLOGICAL SERVICES IN THE MEDICAL DEPARTMENT¹

By ROBERT J. LEWINSKI, Lieutenant, Hospital Corps, United States Naval Reserve

A general survey of the inauguration of psychological work in the United States Navy has been presented elsewhere (1). It was pointed out that psychologists, commissioned in the Naval Reserve Class H-V (S), were to serve in dual capacities: (a) As members of neuropsychiatric boards at Navy and Marine recruit reception centers, and (b) in connection with the selection of aviation personnel. The purpose of the present paper is to describe specifically the psychological services operating in connection with the medical department of the Great Lakes Naval Training Station.

Psychological services at the Great Lakes Naval Training Station were initiated in July 1941. At that time the Psychiatric Board was reaching final formation, and the addition of a psychologist as a member evidences the fact that a close articulation should and does exist between psychological and psychiatric functions. The Psychiatric Board, consisting of one line officer, one medical officer of the regular Navy, two psychiatrists, and one psychologist, is chiefly concerned with the disposition of those recruits who display inaptitude

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for naval service.² The psychologist, as a member of this board, is in position to render advice concerning the inaptitude of recruits which results primarily from psychologic, rather than psychiatric, disability.

Recent research has shown that psychological technics can be of value in the understanding and interpretation of various psychiatric defects. Wechsler (2), for example, has demonstrated that performances on psychometric tests can give considerable insight into such conditions as organic brain disease, psychopathic personality, and psychotic and psychoneurotic states. The psychologist can thus in many instances contribute to psychiatric differential diagnosis. In dealing with naval recruits, however, disabilities more specifically psychologic in nature constitute the problems most frequently encountered by the psychologist.

Recruits are referred for psychological examination for numerous and varied reasons. These reasons for referral have been grouped under descriptive categories and are presented in table 1. Three hundred illustrative cases were selected at random for statistical analysis. It will be noted that in the majority of instances (60 percent), the referral was made because of suspected mental retardation or inferior school records. While an inferior school record is not in itself indicative of mental deficiency, experience has shown that it is frequently advisable to refer recruits with such records for psychometry. In some instances recruits are referred because of low scores on the O'Rourke General Classification Test. It has been found that many of these men possess adequate general intelligence but are handicapped on the classification test because of marked reading defects. This can be determined only through individual examination. In cases of general maladjustment, psychological examination often demonstrates that an underlying subnormal mental development is an influential causative factor in such inadaptability. In the other categories noted, psychological findings are requested and are used to substantiate final psychiatric diagnosis.

TABLE 1.—*Reasons for referral*

Reason	Number of cases	Percent
Inferior school record and suspected mental deficiency.....	180	60.0
Low general classification test scores.....	21	7.0
Dull or peculiar appearance.....	20	6.7
General maladjustment (drug addiction, inability to learn, general inaptitude, nostalgia, insolence, uncleanness, malingering, etc.).....	20	6.7
Somatic complaints.....	17	5.6
Prisoners (referred to determine mental status).....	12	4.0
Enuresis.....	9	3.0
Emotional immaturity and instability.....	6	2.0
Speech defects.....	3	1.0
Miscellaneous (peculiar mannerisms, habit spasms, tremors, masturbation, unresponsiveness, etc.).....	12	4.0
Total.....	300	100.0

² The Psychiatric Board is currently known as the Aptitude Board.

TABLE 2.—*Sources of referral*

Source	Number of cases	Percent
Receiving line.....	217	72.3
Company commanders.....	28	9.3
Classification office.....	21	7.0
Station dispensaries.....	21	7.0
Discipline office (prisoners).....	12	4.0
Trade schools.....	1	.4
Total.....	300	100.0

The sources of referral are presented in table 2. Approximately three-fourths of all cases are referred directly from the receiving line, following a summary psychiatric interview. Those recruits referred by their company commanders are usually those who have shown inability to adjust during their detention period. Recruits referred from the classification office are generally those receiving low general classification test scores, while those referred from the station dispensaries usually present functional somatic complaints, enuresis, and emotional immaturity and instability. Subjects referred from the discipline office are invariably prisoners who have been in the service for some time and on whom psychiatric and psychological examination is desired.

Since the beginning of psychological services to the time of writing, mental deficiency has accounted for 27.3 per cent of the inaptitude discharges given at this training station. The detection of the mentally deficient recruit is not a simple problem. Since in the vast majority of instances the feeble-minded individual differs in no way, physically, from the normal, he escapes scrutiny by most persons. It is known, however, that the mentally deficient recruit is a military liability and therefore he should be eliminated from service as soon as possible. Two clinical instruments have been used in making such psychological determination: The Kent oral emergency test (3) and the Bellevue-Wechsler adult intelligence scale (4). The former test can be administered in from 8 to 10 minutes and is of value when a rapid and approximate measure of intellectual ability is desired. The merits and limitations of this examination have been determined by the writer through qualitative and quantitative analysis and have been presented in a previous paper (5). Because it is essentially an "emergency" test, it is inadvisable to make a diagnosis of mental deficiency on the basis of this examination alone. When recruits receive suspiciously low scores on the Kent test, it is the policy to administer the more exacting Bellevue-Wechsler scale. Although the use of the Bellevue-Wechsler scale is handicapped by the length of time necessary to administer it, it is recommended when a precise measure of mental ability is desired. One of the special merits of this scale is that it consists of two parts, a battery of verbal tests, and

a battery of performance (nonverbal) tests. The performance battery is of particular value when testing those possessing a speech or language disability.

There is a tendency on the part of many to make diagnoses of mental deficiency on the basis of intelligence quotients alone. Numerous pitfalls confront those so disposed. It should be borne in mind that the intelligence quotient (I. Q.) merely represents a ratio—a ratio between the subject's chronological age and his mental age as determined by standardized tests of intelligence. To regard the I. Q. as an absolute measure of intellectual ability is an erroneous procedure. No test of intelligence is infallible; therefore, scores obtained on psychometric tests must be interpreted in terms of such factors as the subject's academic history, cultural background, social adjustment, and especially in the light of the examiner's clinical experience.

A common problem is that of illiteracy and semi-illiteracy. The frequency with which this problem is met is dependent in part upon the educational standards of the localities in which the recruits have lived. Those localities known to have comparatively poor educational standards account for the majority of cases of illiteracy seen at this station.

It is one thing to determine merely whether or not a recruit can read or write; it is quite another to determine whether he can read and understand what he has read by means of a standardized method. To meet this need, the writer has constructed a reading test which has been used profitably in the rapid examination of reading rate and comprehension. This test, based on selections appearing in the *Bluejackets' Manual* (6), contains words and phrases which the average recruit may be expected to read during his naval career. In giving this test, the recruit is asked to read the following paragraph aloud and at his normal rate of speed:

You are now in the Navy. It will be a new life for you, and you may become homesick and lonesome for awhile. To avoid this, write home often and ask your folks to write you often. After you are placed in a company of about 120 men, you must stay in detention for 3 weeks. This is to prevent the spread of serious diseases. A chief petty officer will be in charge of your company. Listen to him. Do what he tells you to do. Take your problems to him. Above all, work hard and study hard. A good thing to keep in mind is this: Yours is a profession, not a job. Your future depends upon the amount of work, study, and effort you put into it.

When it is found advisable to measure reading comprehension as well as reading facility, the following questions may be asked orally immediately following the reading:

1. What should you do to keep from being homesick?
2. How many men will be in your company?
3. Why must you stay in detention?
4. To whom should you take your problems?
5. Upon what things does your future depend?

Employment of this test has shown wide individual variations in both reading rate and reading comprehension. Excluding the existence of a specific reading disability, such variations can be attributed to differences in mental age, education, and chronological age. The administration of the reading test has in many instances proved to be a valuable supplement to the test of general intelligence in evaluating a recruit's probable adjustment in the service.

Cases of illiteracy and semi-illiteracy invariably present complex problems regarding disposition. There are some recruits who possess normal and above-normal intelligence, but who, because of various reasons, have never learned to read or write sufficiently well. It is then the problem to decide whether the recruit is motivated to the degree that he will remedy this condition himself through study, or whether he is disinterested to the extent that he will become a Navy liability. It is not infrequently found that basic personality disorders of a constitutional type accompany the specific psychological disabilities mentioned above.

The problem of inadequate and insufficient education is frequently encountered. Although this problem is a common cause for referral for psychological examination, it should not be inferred that this necessarily implies subnormal intellectual development or actual feeble-mindedness. Investigation has shown that the matter of inadequate education can be traced to many causes, the most outstanding of which are as follows:

1. A transient family.
2. Need of employment.
3. Lack of interest in school.
4. Inability to learn.

The first two causes are distinctly environmental and are readily understood. The third cause must be regarded with suspicion while the last cause is often symptomatic of intellectual deviation.

It is periodically discovered during the psychiatric interview that a recruit has a record of delinquency consisting of one or more juvenile infractions. In such cases it is important to determine the underlying causes of such delinquency; i. e., whether it resulted primarily from environmental factors, psychological factors, or combinations of these. If it can be shown that the recruit's delinquency ensued largely from environmental factors, it would be unfair to bar him from naval service. If, on the other hand, it can be shown to result from such psychological factors as mental retardation or the formation of asocial attitudes, more consideration should be given the recruit before final acceptance is approved.

It is a routine experience to observe that many recruits are upset emotionally when appearing in the receiving line. During the medical examination this is apparent in the frequent manifestations of

temporary tachycardia and hypertension which disappear after the excitement of preliminary examination is over. Because of this, the administration of a psychological examination should be approached tactfully and with caution. It is best, if possible, to avoid direct reference to "psychological examinations" within hearing of the recruit, because of the common beliefs and superstitions that surround such examinations (7). If the examiner can put the subject at ease and readily establish rapport, the most difficult part of the examination is over. Results obtained while a recruit is in a state of anxiety are to be regarded with extreme care when evaluating his psychological abilities and disabilities.

The writer has attempted to present concisely the functioning of psychological services in conjunction with the medical department of the Great Lakes Naval Training Station. Without doubt, these operations vary at other training stations. Since such services are comparatively new in the Navy, many new developments may be anticipated in the future. Even at the present time, however, it is obvious that close relationships among medical, psychiatric, and psychological procedures can be expected to yield a more expeditious elimination of those recruits who are basically unfit and inapt for naval service.

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NEUROPSYCHIATRY IN THE UNITED STATES NAVY ¹

THE 5-MINUTE NEUROPSYCHIATRIC EXAMINATION

By CALVERT STEIN, Lieutenant, Medical Corps, United States Naval Reserve

The present form of the 5-minute examination has been developed as a result of the study of 3,000 men, consisting of 1,000 Army inductees ² and 2,000 officers and men of the United States Navy. The

¹ Received for publication July 20, 1942.

² Stein, C.: A neuropsychiatric examination in 5 minutes. *New England J. Med.* 224: 920, May 22, 1941.

paper is written in two parts. Part I is designated for those who are already familiar with clinical neuropsychiatry. Part II is a detailed description of the test.

PART I. TECHNIC OF THE 5-MINUTE NEUROPSYCHIATRIC EXAMINATION

Greeting the applicant with a smile and a pleasant "Good morning, Smith" is invaluable in creating desirable rapport. The name must be pronounced correctly however; ask him when in doubt.

The applicant remains standing on entering the examining room, observed for ataxia, atrophy, fibrillary twitching, and Romberg. He then extends his hands for notation of tremors, followed by tests for synergy, rapid alternation of pronation and supination of forearms (dysdiadokokinesis), then finger-to-nose test for ataxia, and finger-to-finger test for dysmetria (integrity of pyramidal and cerebellar pathways).

The candidate kneels on a chair for Achilles tendon reflexes, which are usually more reliable than knee jerks for ascertaining the integrity of the posterior columns, pyramidal tracts, and peripheral nerves of the lower extremities. Tendon reflexes of the arm and forearm (biceps, triceps, and radials) are tested to verify the integrity of the thoracic and lower cervical segments of the spinal cord as well as to check on the pyramidal tracts and the peripheral nerves of the upper extremities.

The pupillary reflexes (cervical sympathetic, optic, and oculomotor nerves) are then observed, and tests made for ocular coordination, muscular paralysis or weakness (oculomotor, trochlear, and abducens nerves), nystagmus, and other anomalies.

The facial, the motor division of the trigeminal, and the hypoglossal cranial nerves are tested rapidly, the examiner himself making the appropriate movements in demonstration. Thus: "Let me see your teeth; whistle; wrinkle up your brow (the seventh nerve); open your mouth wide (the motor division of the fifth nerve); stick out your tongue (the twelfth nerve)."

Vision and hearing are examined by the oculist and otologist. Sensory and gross neurological complaints are easily elicited by means of selected questions which also serve to bring out most of the important psychiatric data.

Before putting the following questions, a brief reading of the candidate's confidential questionnaire (see sample below) serves to reveal the educational, occupational, and health history of the applicant:

How do you feel?

Has any member of your family ever had a nervous breakdown? Sick headaches? Fits? Convulsions? Epilepsy? Have you?

Do you have any trouble with your stomach?

Do you sleep well? (Sleep and digestion are likely to be impaired first in neurotic persons.)

Do you eat well?

Bowels all right?

Are you taking any medicine?

Do you have any aches or pains?

How about headaches?

Does *anything* bother you?

How do you get along with girls? (If married, with your wife?).

How old were you when you had your first intercourse?

Gonorrhea? Others?

Have you ever walked in your sleep?

When did you last wet (urinate) the bed?

Have you ever fainted? Been knocked out? Been unconscious? Had any dizzy spells? (Let him explain what he means by "dizzy" spell.)

How many times have you been picked up by the police? Been on report?

When was the last time you were drunk? How much did it take?

At least two-thirds of the men will give a negative history on examination. Additional time and questioning are indicated for the remaining doubtful ones and for those whose findings are patently unsatisfactory.

PART II. DETAILS OF THE ABBREVIATED NEUROPSYCHIATRIC EXAMINATION

No elaborate or printed forms are required. The samples used may be modified to suit the needs of any station or unit, and are easily run off on a mimeograph machine.

FORM 1. THE CONFIDENTIAL QUESTIONNAIRE

CONFIDENTIAL—FILL IN WHILE WAITING. Date _____

Last Name: _____ First _____ Middle _____

Age? ____ Birth place? _____ Home town? _____ Married? ____ Children? ____

Home long on active duty? _____ Seen action? ____ Rating? _____

Last school grade completed? ____ At what age? ____ Repeated grades? _____

Other education? _____

List the jobs you've held, and the length of service in each:

1. _____ 4. _____

2. _____ 5. _____

3. _____ 6. _____

Do you desire submarine service? ____ Why? _____

Do you swim well? ____ Fairly well? ____ Poorly? ____ Not at all? ____

List in approximate order the illnesses, accidents, and operations which you have had and the age at which they occurred.

How do you spend your spare time? (Sports, hobbies, dancing, books, etc.)

A. Before entering the service? _____

B. Since coming on active duty? _____

The procedure here is to have the men fill in Form 1 while waiting their turn. The examiner can usually gain a fair picture of the social, economic, educational, and psychometric assets of the man during a swift perusal of this page. Spelling, writing, significant omissions, and other factors which are discussed on the following pages, will usually serve to round out the first general clinical impression gained from the candidate's appearance, manner of entry, and cooperation during the neurological examination.

ANALYSIS OF THE CONFIDENTIAL QUESTIONNAIRE (FORM 1)

The following points may be elaborated for emphasis:

1. *Place of birth and home town.*—Place of birth and home town afford information on possible nostalgia. Local mannerisms of speech and temperament also help to distinguish a merely bucolic individual from one with defective intelligence.

2. *Duration of active duty.*—An applicant who has had several years of active naval service, has a good conduct record, and has achieved promotion, usually requires much less scrutiny of his intellectual and moral qualities, and of his emotional stability.

3. *Education.*—Several states have only 11 grades of public schooling. Hence mere failure to complete the 12th grade need not in itself suggest a delinquent or unstable youth; although close questioning frequently reveals that the man was either suspended or expelled, or would have been—usually for habitual trancies. The reason for leaving school before completing high school should be ascertained. Frequent trancies, assaulting schoolmates or teachers, and other juvenile delinquencies often foreshadow later conflicts in a potential psychopathic personality. The questions are asked with good humor: How did you get along in school? What kind of marks? I suppose you played hooky a few times? When the reply is in the affirmative, the examiner smiles and asks: Did you get caught? What did they do to you? Did you have some scraps with your teachers? With your schoolmates?

A youth who has physically assaulted his teacher or principal (except under extreme provocation and in self-defense) is more liable to become a disciplinary problem. His manner of reporting the situation usually reveals a great deal in helping to determine how much weight the examiner should give to the encounter. Evasiveness invariably implies guilt.

The element of low marks may not be an indication of intellectual handicap, but is significant in the presence of repeated school failures.

If there is a discrepancy between the age of leaving school and the number of grades normally completed (six plus chronological age), the examiner must ascertain the age at which he began school, whether or not he spent a year in kindergarten, whether he repeated any grades,

how much time was lost on account of illness, traveling, etc. One case of disabling asthma, one of renal calculi, and many cases of juvenile delinquency were discovered in this way—the discrepancy in years being accounted for by the time spent in hospitals or in the reformatory. These men had concealed the data in order to get into the service.

4. *Occupations.*—The data on jobs is most informative. Absence of employment need not be significant in a youth of good family and adequate financial means. However it may reveal an immature and overprotected mamma's boy or a shiftless and indolent youth who never took the trouble to help out by earning at least his own spending money.

FORM 2. NEUROPSYCHIATRIC CONSULTATION REPORT ON -----/ /43

	Name	Date
FAMILY HISTORY :	Father :-----	(Occupation, health, age, date and causes of death, nervous break-down, sick headaches, insanity, epilepsy, fits, convulsions, feeble-mindedness, and other relevant data.)
	Mother :-----	
	Bros.-----Sis.-----	
	Wife-----Childr-----	
CRIMINAL :	Juvenile?-----	
	Adult Civilian?-----	
	Military Conduct?-----	
ALCOHOLISM :	(Average consumption, largest tolerance, frequency, drunken driving, solo drinking, etc.)	
SOCIAL AND SEX :	(Normal autoerotism? normal hetero? perverse? homo? over repressed? venereal diseases? etc.)	
PRESENT HEALTH :	Sleep:-----	Nightmares-----
		Somnolence-----
	Somnambulism-----	Enuresis-----
	Digestion-----	Heartburn-----
		Appetite-----
	Cathartics-----	Weight-----
		Headaches-----
	(With nausea?-----	Disabling?-----
		Frequency-----
	Localization, cause, etc.-----)	
	Dizziness:-----	(let him describe it). Tinnitus?-----
	----- (duration, frequency, postural, faintness, etc.)	
	Seizures: (Fainting, convulsions, unconsciousness, head injuries, amnesia, "black-out" spells, "shakes") double vision, blind spots, urinary urgency, tingling, numbness, etc.-----	
	Others: (Complaints, medicines, sedatives, tobacco, etc.)-----	
NEUROLOGICAL EXAMINATION :	Gait-----	Cranial nerves-----
		Cerebellar path-ways-----
	Pyramidal tracts-----	Extra-pyramidal syndrome-----
		Sensation-----
	(Nystagmus, tremors, ataxia, rigidity, weakness, reflexes, etc.)-----	

PSYCHIATRIC	Intelligence-----	Judgment-----	Balance-----	Sta-
EXAMINATION :	bility-----	Orientation-----	Delusions -----	Halluci-
	nations-----	Affective response-----		
	("Jitters", palpitation, compulsions, defective speech, over-			
	talkative, seclusive, nail biter, lacrimose, nostalgic, surly,			
	preoccupied, inattentive, fatigued, meaningless gestures,			
	unprovoked mirth, tics, mannerisms, etc.) -----			

IMPRESSIONS AND	-----			
COMMENTS :	-----			
RECOMMENDATIONS :	(V, ?, or X.) ----- Approved? ----- Signed-----			

A history of many jobs of short duration frequently suggests maladjustment, incompetence, or shiftlessness. Psychopaths are frequently discharged for arguing with or assaulting fellow workers or even the boss. Men who are habitual offenders against military discipline invariably have a history of repeated conflicts with authority dating back to earlier years both in employment and in school.

5. *Previous health record.*—Of particular significance are the following: Influenza, encephalitis, anterior poliomyelitis, "nervous breakdown," which in a child frequently means Sydenham's chorea, injuries to the head from falls, accidents, or boxing, and convulsions.

6. *Spare time occupation.*—When the answer to this question is omitted or when it is given as "Haven't any" or just "Movies," the examiner may suspect chronic alcoholism, extreme introversion, or a mild depression.

It is unwise to permit the candidate to see form 2. Consequently it should be run off on a separate sheet until the examiner is familiar with the data and questions. Later, in the interest of economy and space, form 3 may be substituted for it, and mimeographed on the reverse side of form 1.

The family history.—Appropriate questioning is restricted to relevant neuropsychiatric data. Essentially we are interested in the presence of migraine, convulsive disorders, psychosis, and feeble-mindedness in the immediate blood relations. Only secondarily, and for treatment, are we interested in divorce, desertion, and repressed resentment toward step-parents as a basis for emotional instability.

FORM 3. DO NOT WRITE ON THIS SIDE ALTERNATIVE FORM 2¹

F (father)_____

M (mother)_____

B (bros.)_____ S (sis.)_____ W (wife)_____ Ch. (children)_____

Cr. (criminal) Sch. (school delinquencies)_____

Civ. (civil arrests)_____

Mil. (military offenses)_____

Al. (alcoholic habits)_____

S. & S. (social and sexual)_____

Hlh. (health) Slp. (sleep)_____ smb. (somnambulism?)_____

sml. (somniloquence)_____ (nightmares)_____ en. (enuresis)_____

dg. (digestion, bowels)_____ hdch. (headaches)_____

szs. (seizures)_____ dzs. (dizziness)_____ ftg. (faints)_____ conv. (convul-

sions)_____ ucs. (unconsc.)_____ hd. inj. (head injury)_____

oth. (others)_____

Neurological examination (positive data only)_____

Psychiatric examination: intl. (intelligence)_____ jdt. (judgment)_____

bl. (balance)_____ stb. (stability)_____ mty. (maturity)_____

inst. (insight)_____

wsh. (wishes)_____

wlth. (wealth)_____

Impression & comments:_____

Recommendations: (V? or X)_____ Signature:_____

¹ Form 3 may be used, with any suitable symbolic abbreviations for convenience and economy of paper and filing, on the reverse side of Form 1, without revealing the procedure to the candidate.

The following questions are designed to secure the most information in the least possible time; they should be put tactfully and pleasantly to eliminate resistance:

What does your father do for a living?

Is he in good health?

Is your mother (in good health)?

How many brothers have you? Sisters? How many are older than you?

(An only or favorite son is usually burdened with a larger share of complexes and emotional immaturity.)

Are they all in good health?

Has any member of your family ever had a nervous breakdown? (Since the term covers a multitude of symptoms, one must ascertain what it was; thus: Was the relative hospitalized? Was it a mental hospital? Were there outstanding changes of personality? Crying spells? High blood pressure? A stroke? Any insanity? Feeble-mindedness? Epilepsy?)

Has anyone in your family ever had a fit or convulsions? Have you?

How about headaches? (Unilateral recurrent headache with nausea or vomiting suggests migraine.)

If migraine or convulsions have been present in the immediate family history, and there is also a suggestive convulsive diathesis

in the individual applicant (such as a history of convulsions in childhood, and more recent somnambulism) it is considered that he has two strikes on him already. The same is also true when there is a presumptive psychosis in a parent or sibling and a strongly neurotic or unstable tendency in the applicant.

The health of the wife, the number and health of the children, and the prolonged practice of coitus interruptus are obviously important. Questioning on this score must be tactful and patient, however, since in many cases of mixed or forced marriages there are religious and moral scruples which make the task of eliciting the desired information a delicate one.

The presence of marital conflicts is so frequently a factor in cases of anxiety neurosis which come to the sickbay that it is clearly important to investigate them in the prospective candidate for submarine or other combatant military duty.

Delinquency and criminalism.—The candidate is immediately thrown on the defensive by wording the question: "How many times have you been picked up by the cops?" rather than asking "Were you ever arrested?" Invariably he searches carefully for isolated experiences when he was either held for questioning, hauled in for Hallowe'en pranks, or given warnings for traffic violations, etc.

Such data in themselves may not be significant; but when combined with several offenses against society in the nature of theft, assault, battery, rape, desertion, drunken driving, and the like, it requires a very good conduct record of at least 2 or more years in the military service in order to show that the man has overcome his antisocial habits. In many cases one or more of the following conditions exist: Constitutional psychopathic inadequacy, defective judgment, habitual alcoholism.

Alcoholism.—The terms "mild," "moderate," or "heavy" are too vague for adequate description. "When was the last time you were drunk?" and "How much did it take?" are effective questions. When answers appear to be too guarded, it is frequently useful to phrase the question in this way: "Well, how many beers can you hold without losing control?" and "How much whiskey (or rum, gin, or brandy) can you handle without getting drunk?" or "and still be able to walk home without help?" The candidate usually responds to this challenge with amazing frankness, so that claims of imbibing a case of beer (280 ounces, or over 2 gallons) and/or a quart to 3 pints of whiskey or gin in an evening are not uncommon.

It is recognized that individual capacities vary considerably; that the same amount of liquor taken during an evening does not necessarily incapacitate a man as it would if taken all at once, or during a single hour or two, or on an empty stomach; that one's tolerance as well as his liking for drink can be steadily increased; and that

one's motives for drinking even large amounts need not constantly indicate a psychopathic personality, since the element of habit and the conduct of one's associates and the possibility of a recent "heart-ache" must also be considered.

Signs of cerebellar intoxication, as shown by the ataxia (unsteadiness) and tremors of the extremities (and not infrequently of the head also) are presumptive of recent alcoholic excesses. Unless other organic disease such as multiple sclerosis can explain the findings, it then depends upon the circumstances as to whether or not the "celebration" may be considered to be "normal." Thus, in a youth of 18 years, away from home for the first time, a party lasting over many hours, plus the fatigue and excitement of a journey, may well be ignored if his record is otherwise clean and industrious. On the other hand, in an old-timer who knew that he was reporting for a tour of intensive training duty, and who has a record of several arrests for being overleave or for intoxication, the clinical evidence of intoxication must be weighed more carefully.

Finally, while no definite limits can be set on the number of drinks that may be considered to be within normal limits, it has been found here that the average normal, well-adjusted youth tends to take from 1 or 2 up to 6, 8, or 10 (10-ounce) glasses of beer in an evening, * * * the largest number limiting themselves to an average between 3 and 5 glasses per evening. In old-timers, even a pint of whiskey, or a gallon of beer may be tolerated without showing up in a lowered threshold of nervous stimulation or in misconduct. It is only when these quantities are taken regularly several times per week by youngsters, or when the amounts run to three or four times the average amount in older men, that the examiner must make careful inquiry into the rest of the social, delinquent, emotional, and personal history of the individual.

When in doubt, these two questions frequently elicit valuable information: "What do you like to drink when you're alone?" and "When you wake up in the morning after a big night, which do you prefer, wine, whiskey, or beer?" The confirmed alcoholic doesn't mind drinking alone; while the moderate conservative drinker usually prefers water, milk, or coffee in the morning after a hang-over.

Other drugs.—While seldom of clinical significance in these examinations of seamen, inquiry should be made as to the habitual excessive use of marihuana, headache powders, aspirin, bromides, sedatives, cathartics, the cola beverages, and tobacco, especially in every doubtful case.

Social and sex.—The subject is opened with the casual inquiry, and an indulgent smile: "How do you get along with girls?" or "Do you ever intend to marry?" Have you a girl friend? If married, "How do you get along with your wife?"

The response to the opening question usually furnishes the lead for subsequent questions. Since the question of venereal disease has already been gone into by the medical examiner, and is usually already recorded in the man's health record (although he frequently conceals the fact if he can) we are concerned here largely with the question of perversion. To this end the examiner must exercise considerable care in selecting and presenting his questions. Thus: "Have you ever had intercourse with (or been out with) a woman?" brings an amused affirmative reply from the average normal heterosexually adjusted man. In the more conscientious youth the reply is often a shamefaced "Yes" or "A few times." For the old-timer, "How old were you when you had your first intercourse?" may be preferable.

Respect for religious and moral scruples are shown by alteration of the tone of the examiner whose next question "Have you ever been burned?" or "had a dose?" or "picked up an infection?". This question is asked in such a way as to imply that this was the only information that the questioner was really interested in. When an otherwise intelligent fellow gets "burned" twice in succession, one might well question at least his judgment, if not his stability.

When the answer to the heterosexual inquiry has been negative, the next question usually brings out enough surprise or shocked resentment, or scornful disdain to furnish the examiner all the information he needs without asking another, and frequently without even looking at the candidate. The question is asked in a careless, indifferent manner: "Have you ever had intercourse with (or been blown by) a man?" or "Haven't you ever had an older man get fresh with you?" or "When was the last time you let another fellow play with you?"

Many times a frank "Yes" has been the answer to the first of these questions. Frequently the reply is a cautious "Well, not exactly." When the answer is a scornful "Certainly not," or "I should say not," or "Hell no," the examiner calmly proceeds with inquiries on health.

The extent and circumstances of the relationship, and the number of years that have elapsed since the last indulgence are the factors in determining its significance in estimating the man's moral quotient.

The social habits of a man—his inability to dance, his dislike for parties and girls, and his tendency to drink alone—frequently reveal a great deal concerning his emotional stability. The lone wolf is at least a potential misfit.

Health.—A fleeting but fairly comprehensive investigation into the systemic history of the man is valuable in revealing data on possible encephalitis, epilepsy, tumor, or other encephalopathy. Of particular interest is evidence of any of the following conditions: Habitual insomnia, excessive sleep-talking and nightmares, sleep-walking, recent habitual bed wetting, convulsions, petit-mal seizures, syncope,

chronic indigestion, chronic constipation, coma, migraine, headaches, vertigo, tinnitus, head injuries, and amnesia.

Short cuts in the questioning may be developed by the examiner as he becomes more familiar with the procedure. For example: "Has anyone in your family ever had a nervous breakdown?" "Anyone had any fits or convulsions?" "Have you?" "How about headaches?" "You've *never* had a headache?" This last question asked with obvious disbelief promptly puts him on the defensive and keeps him there for the rest of the interview. Invariably, after such a scrutiny, the man becomes more cautious in answering the health inventory; hence it is useful to work in the question on headaches quite early in the examination and to return to the criminal and other histories later.

Other complaints.—Not infrequently the questions "Are you taking any medicine?" "Have you any aches or pains?" "Does anything else bother you?" have elicited data on colic, calculi, asthma, hayfever, and the like. This was overlooked by previous examiners merely because it wasn't considered expedient or necessary to investigate the medical or surgical history so fully. Obviously the less time available per man, the more sketchy and incomplete the study.

The psychiatric examination.—Psychometry may be defined as the science of measurement of the intelligence, i. e., of the capacity to think, remember, absorb information and recall it for use.

"Normal" human intelligence for an adult person is that of an average 15-year old adolescent. The capacity to learn is believed to continue to grow until about the age of 18 years at which a mental age is classified as superior. Any mental age which is below 15 years, but above 10 years, is rated as dull or borderline, while all mental ages below the 10-year level are classified as feeble-minded. The table below lists the common limits of intellectual classification. The three classes below the dotted line are feeble-minded.

TABLE 1.—*Standards of intelligence*

Classification of intelligence	Table of intellectual levels—mental age	I. Q. ¹	Percent of distribution in average population
Superior	17-18 years +	<i>Percent</i> 110-130 +	18
Average (normal)	14-16 years	90-109	50
Dull or borderline	11-13 years	70-89	20
Moron	7-10 years	50-69	3
Imbecile	4-6 years	25-49	
Idiot	1-3 years	0-24	

¹ The term I. Q. signifies "Intellectual Quotient," and represents a numerical value to designate mental capacity to learn. It is obtained by dividing the mental age by the chronological or actual physical age of the individual, and then multiplying the resulting quotient by one hundred in order to express it as percent.

For example, a moron who is actually or chronologically 15 years old, but has a mental or intellectual age of only 9 years, would have an intellectual quotient of 9/15 or 60 percent. For calculation purposes only, all adults are given a chronological age of 15 years. Therefore, an adult with a mental age of 9 would also have an I. Q. of 60. An adult with a mental age of 18 years would have an I. Q. of 18 divided by 15 \times 100 equals 120 which is superior intelligence.

The measurement of intelligence is ordinarily a time consuming procedure, and short-cuts depend largely upon the clinical experience of the examiner. Thus, stupidity or clumsiness in executing instructions, gross carelessness, ungainly posture or appearance, congenital anomalies, vasomotor and autonomic disturbances (cyanosis, redness, cold or sweaty hands)—all these arouse the first suspicion of constitutional inferiority, although, of course, they may also be found in otherwise normal persons, and in those who are very much excited by the examination.

As stated earlier in this paper, a history of less than sixth-grade education or its equivalent, completed successfully at about 12 years of age is a presumptive indication of defective intelligence unless explained by illness or absences from school.

For satisfactory psychometric appraisal the examiner who is unfamiliar with tests for the measurement of intelligence should be guided by a competent clinical psychologist since space limitations forbid adequate discussion of this subject here.

Psychopathy.—The psychiatric examination takes cognizance of all the data that have been discussed above. While frank abnormalities are comparatively rare, the following must be kept in mind for doubtful cases: Orientation. Does the individual know who and where he is? Does he know the date? Can he remember recent events? Remote events? Does he suffer from hallucinations, illusions, delusions? Has he had a "stroke" or "shock"? Have there been changes in his usual personality, forgetfulness, loss of interest, unusual vulgarity or lewdness (suggestive of syphilis of the central nervous system, or of arteriosclerosis, or of a brain tumor or a psychosis). Have there been periods of unusual excitement or enthusiasm, excessive energy alternating with depression, exhaustion, and melancholia, possibly with talk of suicide (manic-depressive insanity)? Have there been unusual restrictions or alterations in diet, e. g., omission of fresh fruits and vegetables, and of dairy products, other vitamin deficiencies, excessive intake of patent and other medicines, or of alcohol and narcotics? Are there absurdities in his imagination or defects in his judgment?

Judgment and emotional stability.—An estimate of the candidate's judgment is made on the basis of his past and present expenditure of time and energy. Repeated offenses against society and the law, as well as abuse of one's energy and resources usually indicates psychopathic deficiency. This is particularly common in the intellectually retarded and in the chronic delinquent.

The following questions throw some light on the innermost ideals of the applicant: "What used to be your greatest ambition?" "What is it now?" "If you had three wishes, and could wish for anything

you wanted, what would you wish for?" "If your wishes all came true, and you also had a million dollars to do with as you pleased, what would be the first three things you would do with it?"

Emotional stability is indicated by one's ability to meet new situations without undue panic. What are his likes, his pet peeves? What does he consider to be the greatest thing in the world? The oldest, the youngest, and the only child especially if he is without any particular assets is especially liable to emotional storms and stress. This is also true of the mentally retarded individual whenever the demands that are made upon him are too much for him to handle—for example studies, responsibility, long periods of concentration, and technical maneuvers.

SUMMARY AND CONCLUSIONS

1. Long as this presentation is its actual use is shortened in direct proportion to the skill and experience of the examiner. Increasing familiarity with the questions will simplify its application.

2. The confidential questionnaire (form 1) and the neuropsychiatric report (forms 2 and 3) may serve merely as a guide, or as a permanent record for reference and surveys. The use of plus, minus, or zero signs may be incorporated to facilitate speed. The disadvantage of having two sheets (forms 1 and 2) which should be stapled together after the examination, is outweighed by two considerations: First, it is not considered wise for the applicant to know the extent of the questions he will be asked on the second page; and second, the mimeographing of a single sheet is more flexible and economical than the printing of forms or cards. In view of the time element required, the practice of having the men fill out the first form on their own time before the examination, has been found expedient. When the examiner is familiar enough with the questions, form 3 may be substituted for form 2 and mimeographed (or printed) on the reverse side of form 1.

3. Contrary to all previous teachings on psychiatric diagnosis, it has been found both possible and expedient to glean an adequate diagnostic picture of the mental and emotional assets and liabilities of a candidate in an average of 5 minutes, where formerly it was the custom to spend several hours.

4. It is important to remember that the essential distinction between these and ordinary neuropsychiatric examinations is that the overwhelming majority of these men do not have any complaints for which a differential diagnosis would be indicated. Consequently they give negative findings, and can therefore be disposed of with considerable ease and speed. Doubtful cases usually require about twice as much time.

5. Not infrequently the candidate misinterprets the questions on sex as referring to masturbation, about which he is liable to be more self-conscious. Such misinterpretation has occurred many times in the long lineup where several hundred men pass through the "boot camp" training station daily, and where the examiner, who is often as fatigued as the men, runs through a rapid fire questionnaire averaging 3 minutes per man. Therefore the examiner must be constantly on guard against too formal a routine, and against intolerant disregard for the individual's responses. Naturally he does better on this score if he can spend 10 minutes with his man instead of 5, even though he may not need all of this time.

6. While guile and cunning and plays of sympathy are considered to be legitimate tactics in the interests of the service, it would be unfair to assume that the examiner is fundamentally a hypocritical, heartless, and calculating inquisitor who is never so happy as when he is scheming and planning trick questions with which to ensnare the unsuspecting candidate. For no one realizes more than the psychiatrist what the full extent of human frailty is. The average applicant usually writes his own ticket by his honesty, his cooperation, and the extent to which he can show that whatever weaknesses he may have impulsively yielded to in the past have been conquered and kept under control over a reasonably long period of time.

7. A handshake, and/or a "Good luck, Smith" at the close of the interview proves valuable, inasmuch as a smiling candidate who leaves the examining room with a "Thanks, Doc," has a better effect on the rest of the men waiting outside, not to mention its psychotherapeutic value to the subject who is liable to have found his interview somewhat of an ordeal.

8. For highest efficiency an examiner should not be required to perform more than 40 of these examinations per day; and it has been found far better to have him work at them for one-half a day doing only 20 examinations and then to spend the rest of the day doing neuropsychiatric consultations or treatment and in familiarizing himself with his other duties in the Medical Department of the Navy.

CLINICAL NOTES

THE ORAL SURGEON, PROSTHODONTIST, AND ORTHOPEDIST AS A TEAM IN DIFFICULT FRACTURES OF THE JAW ¹

REPORT OF A CASE

By A. H. GRUNEWALD, Lieutenant Commander, Dental Corps, United States Navy

Modern warfare and the sulfonamide drugs have considerably altered the procedures employed in the treatment of extensive injuries to the jaw. In cases where a jaw is actually shattered by some form of high explosive, which often happens in modern warfare, many oral surgeons have assumed the attitude that you can't build a brick house out of straw and simplified the whole procedure by merely taking out the pieces.

That may have been a fair conclusion before the advent of sulfonamide therapy, for where the bone was actually shattered and the fragments extensively compounded they were usually lost by osteomyelitis setting in. It wouldn't do, in the case of a shattered mandible for example, to make an intra-oral form to which to mold the numerous fragments and lock everything in place, so to speak, with proper external pressure. Because continued sterility is impossible and the oral cavity is such an ideal place for infection to start, the above was not considered possible when intra-oral open wounds were present. While such was the case a few years ago, it is not the case today, and many service men who would have come back looking like Andy Gump will now look like normal human beings because of it.

That being true, the responsibility of the prosthodontist and orthopedist in such cases becomes far greater than it previously has been.

The oral surgeon can't keep a few fancy gadgets on the shelf and then select one that fits a particular case, any more than the prosthodontist can keep a few sets of dentures on the shelf and send a patient off satisfied with the one that fits the best. There are accepted extra-oral appliances and various stainless steel plates, etc., that may be almost indispensable in certain cases where the bone has not been too extensively comminuted. Every really difficult case is a prob-

¹ Received for publication September 8, 1942.

lem in itself, however, and where special appliances are required the oral surgeon and prosthodontist must work together, with the orthopedist, in devising and making whatever is necessary. If the dental officer is both an oral surgeon and prosthodontist and has the required facilities the situation is of course ideal. If not they must work together for the patient's greatest welfare.

The physician's role in the treatment of cases under consideration is so clear and invaluable as almost to go without saying. Where possible, he should be an orthopedist, in order that his greater knowledge of bone injuries in various parts of the body can be utilized, as well as his indispensable aid in the administration of the various therapeutic measures that may be required.

Following is the report of a case, the treatment of which was brought to a satisfactory conclusion through the cooperation of Lt. Comdr. L. O. Parker, (MC) USNR.

CASE REPORT

The patient was shot in the lower jaw with a 45-caliber bullet at 10 feet. The bullet entered at the superior third of the root of the left cuspid. It then passed downward through the root of the tongue and entered the middle of the mandible opposite the right second molar. All of the teeth on the left side from the second bicuspid to the right central, as well as the superior third of the mandible, were blown away. The chin, and remainder of the mandible back to the second bicuspid on either side, were extensively comminuted and compounded. The entire remainder of the body of the mandible on the right side was literally shattered, and pieces were blown into the cheek, floor of the mouth, and through the wound of exit (figs. 1 and 3).

The right central, lateral, cuspid, first bicuspid and half of the crown of the second bicuspid remained in the patient's mouth, but were so loose that they and the section of alveolar process that normally retained them in position could have been removed with finger pressure alone. The second bicuspid, first molar, and second molar on the left side remained in a normal position. The third molar on the same side was unerupted. The entire mandible, however, from the second bicuspid on the left to the ramus on the right was comminuted and compounded internally and externally. Hemorrhage and shock were moderate.

At the end of the first 18 hours, swelling was so great, due to the extensive injury to the tongue, that the patient could not swallow and respiratory obstruction was noticeable in the glottis. Temperature was 103.4° F., hemoglobin 13.0 gm. or 84 percent, erythrocytes 4,530,000, leukocytes 10,800, Kahn negative.

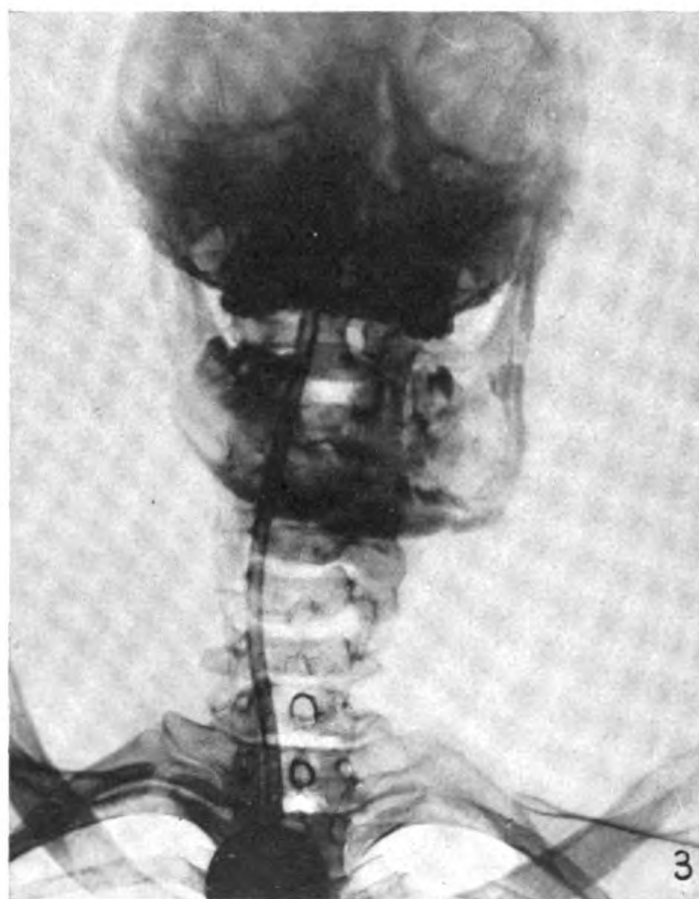


1. LATERAL VIEW OF MANDIBLE 5 DAYS AFTER PATIENT WAS SHOT WITH .45 CAL. BULLET ENTERED AT LEFT CUSPID AND CAME OUT OPPOSITE SIDE IN SECOND MOLAR. NOTE FEEDING TUBE IN PLACE.—2. LATERAL VIEW RIGHT AFTER CASE WAS SET. NOTE APPLIANCE ON UPPER IN PLACE. LUCITE SADDLE EXTENSIONS THAT PIECES OF MANDIBLE WERE MOLDED TO DO NOT SHOW ON X-RAY.

He was given 500 cc. of blood, 500 cc. of human plasma, 1,500 cc. 5 percent glucose in normal saline, and 10 gm. sodium sulfadiazine by the end of the first 24 hours.

At the end of the third day the temperature was down to 100° F. Swelling was less, but the patient was still unable to swallow. A nasal tube was passed for feeding and medication. He was then given 3,000 calories of liquid diet through a tube and 8 gm. of sulfadiazine daily for the first week.

PLATE 13



3. ANTEROPOSTERIOR VIEW 5 DAYS AFTER INJURY. NOTE HOW CHIN IS SHATTERED AND MANDIBLE BLOWN AWAY AT EXIT OF BULLET.

The temperature was normal on the fourth day and signs of general sepsis and toxemia were gone.

Swelling was much improved and patient was able to swallow on the seventh day, so the nasal tube was removed.

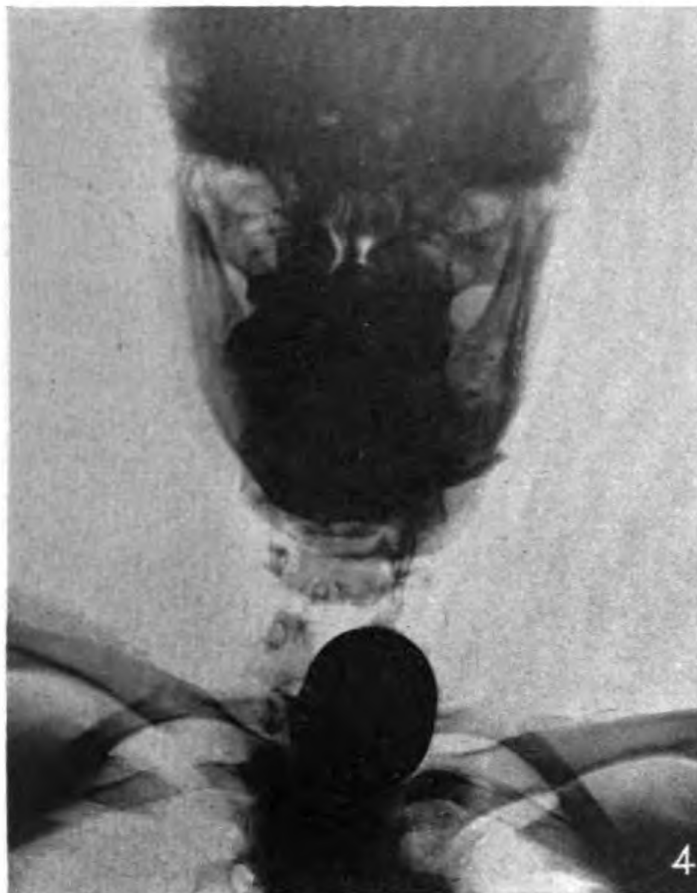
Blood sulfonamide levels ranged from 8 to 14 mg. percent.

Intra-oral examination on the seventh day showed several loose, exposed fragments of bone and a molar tooth in the floor of the mouth. These were removed, care being taken not to remove any

pieces which had any definite periosteal attachment. No secondary infection was present.

Because of the large number of fragments and the extensive mobility of the entire lower jaw, it was obviously impossible to obtain a satisfactory impression, so none was attempted. Some intra-oral form to which the numerous fragments could be molded and which would help to retain the chin in position in counteraction to the distal muscle pull, was however definitely required. The patient

PLATE 14



4. ANTEROPOSTERIOR VIEW IMMEDIATELY AFTER CASE WAS SET.

having a full complement of upper teeth an accurate impression was obtained of the upper jaw. A cast-gold upper partial skeleton was then made, with double crib clasps for retention, labial and palatal bars for stability, and numerous buccal and lingual extensions. The clasps and extensions were so placed as to give a minimum of interference and a maximum of retention where required.

The casting was placed on the upper model and a bite rim of soft utility wax placed over it. This was held in place by the buccal

and lingual extensions as intended. The whole was then removed from the model, the wax further softened in warm water, and put to place in the patient's mouth. The lower fragments were then manipulated, under partial local anesthesia, and a section at a time pressed to place in the upper bite rim. When a satisfactory impression of the entire mandible had thus been obtained, the upper skeleton and wax were removed and the wax form transferred into Lucite. Excessive irregularities in the Lucite saddles were eliminated, so the saddle maintained the form that it was desired the alveolar process in the edentulous areas would assume when healing was complete.

PLATE 15



5

5. LEFT LATERAL VIEW JUST PRIOR TO REMOVAL OF FRACTURE APPLIANCES.

Care was taken, however, to leave the Lucite form sufficiently long on the right side to retain the ramus in normal relationship. The Lucite was also allowed to extend well over the lingual surfaces of the remaining lower teeth, to facilitate holding them in normal relation to the corresponding uppers when the mouth was closed. It was removed from the labial and buccal surfaces of the lower teeth, so that setting and fixing these teeth in normal occlusion, with such additional wires as might be required, could be more easily accomplished (fig. 8).

The upper form was put to place on the twelfth day. The patient was given 0.8 gm. pentothal sodium intravenously and the lower fragments remolded to the Lucite extensions. It was found, that because of the time that had elapsed since injury, the angle of the mandible on the left side was pulled outward, due to a shortening of the masseter muscle, causing a considerable lingual inclination of the teeth in the left posterior segment. Wires were placed about these teeth and the corresponding uppers, and the teeth brought into

PLATE 16



6. RIGHT LATERAL VIEW JUST PRIOR TO REMOVAL OF FRACTURE APPLIANCES.

proper occlusion and fixed with considerable difficulty. The excessive salivation caused by the pentothal sodium added to the difficulties otherwise present. The teeth on the right side were wired with very fine wires, using a minimum of tension to prevent their tipping and to hold them against the stabilizing extensions of Lucite in this area. The general relationship obtained was then held in place with a 3-inch elastic bandage.

X-ray examination was made the day following and showed the fragments to be in satisfactory alinement (figs. 2 and 4).

The sulfadiazine was discontinued at this time.

The patient complained of moderate discomfort and was given daily sedatives for the first week to keep him as quiet as possible and thus aid in retaining the elastic bandage in position. There was slight localized intra-oral drainage during this period, from several small bone fragments that were exfoliating. The elastic bandage was changed at required intervals, so that a constant, desired external pressure was maintained as the external swelling subsided.

On the twenty-sixth day, 2 weeks after the mandible had been set, the elastic bandage and interdental wires were removed. The mouth

PLATE 17

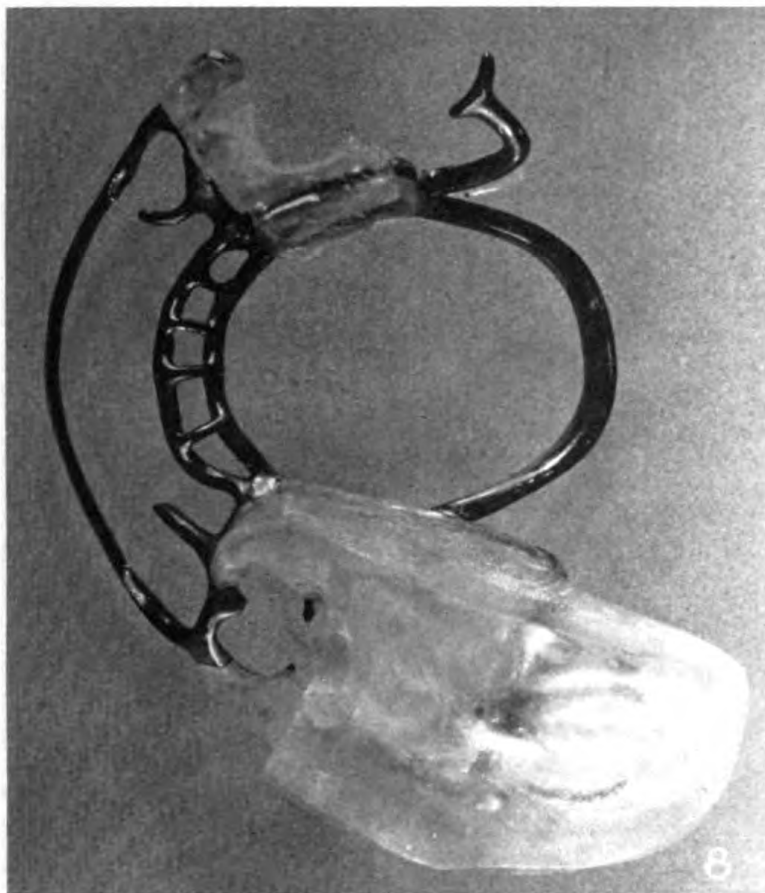


7. ANTEROPOSTERIOR VIEW TAKEN JUST PRIOR TO REMOVAL OF FRACTURE APPLIANCES.

was cleaned and all visible denuded fragments removed. The swelling of the soft tissues having greatly diminished, a plaster impression was obtained of the face, and poured in dental stone. Noted depressions in the external surface of the mandible, caused by pressure of the elastic bandage over areas of greatest bone loss, were filled in and the model of the face altered to simulate the end result desired in the patient. A countermold was then made of dental stone and a sheet of Lucite pressed to the desired form in boiling water. This

external Lucite form, after trimming, covered as much of the external surfaces of the mandible and cheeks as was possible without interference with the normal movements of the head. The superior border of this face form extended to just below the zygomatic processes. A hole was cut in the form just below the superior border on either side. The sailmaker was then called upon to make a canvas skull cap, with a metal eyelet on either side opposite the holes in the face form (figs. 9 and 10).

PLATE 18



8. INTRA-ORAL APPLIANCE, SHOWING GOLD FRAME-WORK AND REMAINING LUCITE EXTENSIONS AND SADDLE. MUCH OF THE LUCITE WAS TRIMMED AWAY AT VARIOUS INTERVALS AND DOES NOT SHOW IN PICTURE.

It was noted at this point that the teeth in the left mandibular segment were in lingual occlusion to the respective uppers. Therefore, two pieces of 14-gage half-round wire were adapted to the buccal surfaces of the three lower teeth and corresponding uppers. Three small hooks of 18-gage round wire were then soldered to each of the above, opposite each tooth. The bars, with hooks, were then wired to the upper and lower teeth, and rubber bands were stretched between the opposing hooks to provide constant lateral traction.

PLATE 19



9. PATIENT WITH LUCITE FACE FORM IN PLACE.—10. LATERAL VIEW OF PATIENT SHOWING MANNER IN WHICH LUCITE WAS TIED TO SKULL CAP WITH RUBBER TUBING. NOTICE HOLE IN LUCITE AT WOUND OF EXIT.—11. LATERAL VIEW OF PATIENT UPON COMPLETION OF CASE. NOTICE SMALL SCAR AT POINT OF EXIT OF BULLET.—12. SHOWING TEETH RESTORED WITH LOWER PARTIAL DENTURE.

The upper intra-oral Lucite form was left in place and the external Lucite form tied to the skullcap with rubber tubing, so as to provide a firm and continued external pressure. The patient expressed his

appreciation of the greater comfort the external Lucite face form provided.

The interdental rubbers were changed, the mouth cleaned, and the sequestra which were visible at the surface were removed at regular intervals for 27 days. Clinical and x-ray examination showed the results to be satisfactory at this time, approximately 8 weeks after injury, so all appliances were removed (figs. 5, 6, and 7).

The fractured right second bicuspid was then removed. The right central had failed to tighten up sufficiently and was considerably out of line, so it was also removed. The alveolar process at the point of entrance of the bullet, being very uneven, was smoothed at this time by a minor flap operation.

The above was allowed to heal for 10 days and a lower impression obtained. It was noticed that while the remaining right lateral, cuspid, and first bicuspid were in good relationship to the upper, the segment of bone holding these teeth in position was not entirely firm. A lower partial denture was, therefore, designed and constructed so as to replace the missing teeth and, through clasps and labial and lingual extensions of the Lucite saddles, aid in further stabilizing this segment. The occlusion was adjusted, so as to place a minimum of strain on the teeth on the right side. The patient was instructed to exercise care in eating for at least a month, to permit further calcification of the right segment retaining the mentioned teeth. His recovery was otherwise uneventful. Facial disfigurement is so negligible as to be unnoticeable (figs. 11 and 12).

CONCLUSIONS

Sulfonamide therapy has altered the treatment of extensive injury to the jaws. Every possible effort should be made to retain, rather than remove, all bone fragments, regardless of how extensively compounded. Because of its kindness to the tissues, Lucite serves as an ideal material for intra- and extra-oral splints in the type of fractures under consideration. Every really difficult fracture of this type, is a problem in itself and requires the ingenuity of the oral surgeon, prosthodontist, and orthopedist working as a team.

FOREIGN BODY (DENTURE) IN THE ESOPHAGUS¹

REMOVAL BY MEANS OF GASTROTOMY AND RETROGRADE ESOPHAGOSCOPY

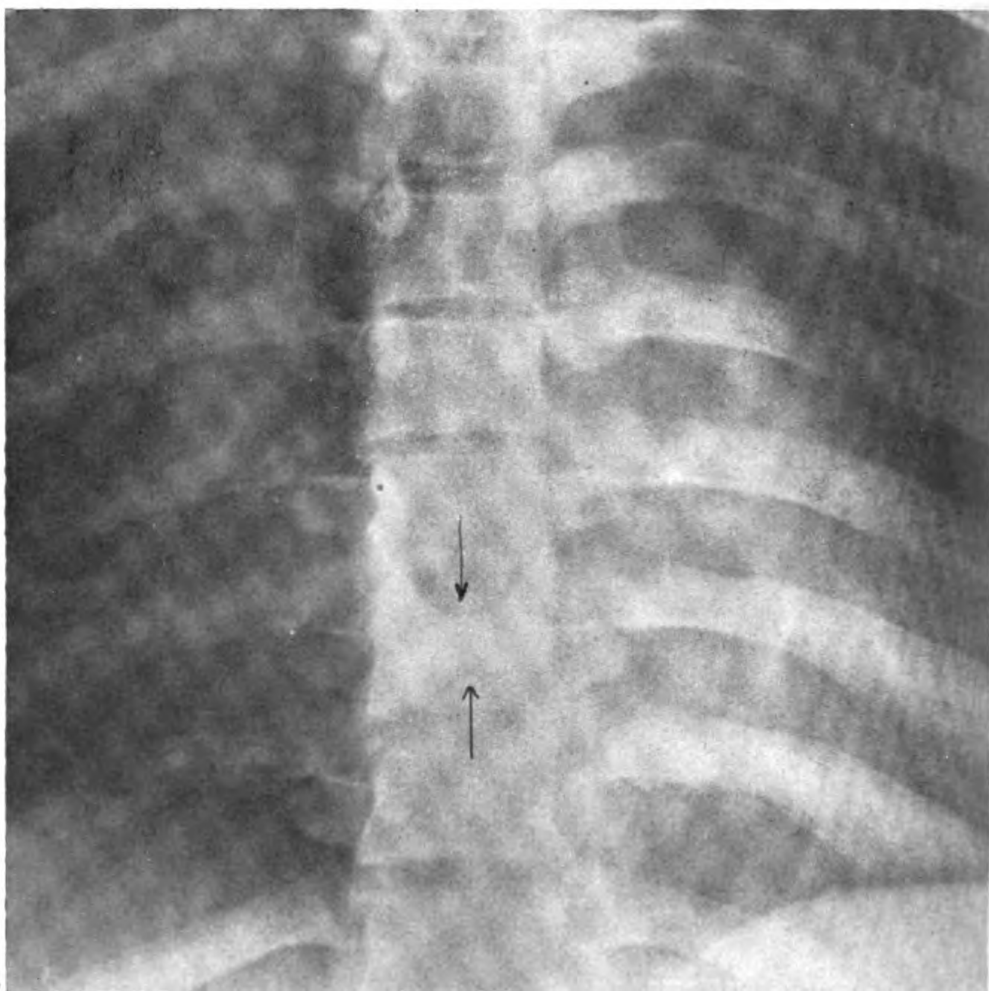
By HORACE R. BOONE, Captain, Medical Corps, United States Navy, retired, and J. EMERSON DAILEY, Lieutenant Commander, Medical Corps, United States Naval Reserve.

It was considered desirable to report this case because of the unusual method of removal of a foreign body in this location. Retro-

¹ Received for publication August 5, 1942.

grade esophagoscopy is most commonly employed in the treatment of strictures of the esophagus. It is infrequent that the circumstances associated with a foreign body in the esophagus demand any other than the usual approach through the mouth for removal. Occasionally, a third method of removal must be resorted to—that of performing an esophagotomy; necessitating an approach through the neck or the thorax depending upon the location at which the foreign body may lie. In this case there were definite reasons why the retrograde approach seemed the safest and the most practicable.

LATE 20



DENTURE IN THE ESOPHAGUS AT THE LEVEL OF THE EIGHTH THORACIC VERTEBRA.

CASE REPORT

History.—G. C. E., a seaman, second class, age 21 years, was admitted June 12, 1942, with fever, cough, and expectoration, and complaining of a sense of pressure in his chest. He stated that about 3 o'clock in the morning of June 10, 1942, he suddenly awakened from sleep with a choking and gagging sensation and discovered that he had swallowed a removable denture which he was in the habit of wearing. He complained of a severe pain in his throat

and was taken to a physician who discovered by x-ray a large, horseshoe-shaped denture, containing one tooth, lodged in the esophagus near the upper end. A blind attempt was then made to remove the denture by passing a wire instrument below, hooking it and pulling upward. This failed and the patient was sent to another town where he was hospitalized and the services of an endoscopist were procured. An esophagoscopy was performed June 11, 1942, and the esophagus was found markedly edematous, torn, and bleeding. The denture was seen with the tooth and convexity extending downward and the sharp prongs upward. Because of its size and shape ($1\frac{3}{4}$ inches by $1\frac{1}{2}$ inches) and the condition of the esophagus, it was felt impracticable or impossible to attempt a version of the object and risk further traumatizing the esophagus. An attempt was then made to force the denture downward into the stomach and it became lodged just above the diaphragmatic pinchcock. Further attempts at removal were not made and the patient was permitted to swallow water, milk, and ice cream which he did with little difficulty. On June 11, 1942, his temperature became elevated to 103° F. and he began expectorating purulent material. On June 12, he was transferred to this naval hospital by plane.

Physical examination.—Examination revealed a well-developed and well-nourished individual. His skin was dry and hot and there was a foul odor to his breath. His mouth hygiene was very poor and mirror laryngoscopy revealed the mucosa of the pharyngolarynx red and edematous. The pyriform sinuses were filled with a purulent exudate. His neck appeared slightly swollen and moderate tenderness was present on deep palpation above the clavicles. No subcutaneous emphysema was demonstrable. His temperature was 103° F., pulse 110, and respirations 18 per minute. The remainder of the physical examination was essentially negative. Upon admission his white blood cell count was 14,450; segmented cells, 79; and band forms, 9.

X-ray examination.—X-ray examination revealed the horseshoe-shaped denture lying in the esophagus at the level of the eighth thoracic vertebra. There was no evidence of abscess or air in the mediastinum.

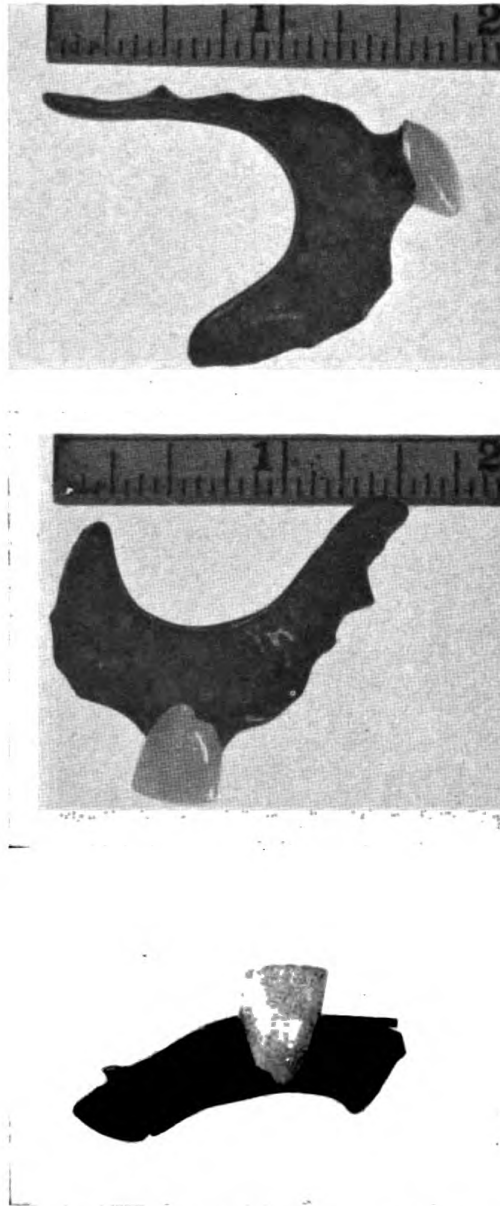
Diagnosis.—This patient had a severe esophagitis due to trauma from the foreign body and two attempts at removal, and was a good candidate for a mediastinitis. It was deemed advisable to delay any further attempts to remove the denture for at least a week and allow the inflammation in the esophagus to subside.

Treatment.—The patient was confined to bed and allowed nothing by mouth with the exception of 1 ounce of sterile water every hour and 1 gm. of bismuth subnitrate placed (dry) on his tongue three times daily. Strict mouth hygiene was maintained by frequent brushing of the teeth and mouth washes every hour with an antiseptic solution. Fluids and some nourishment were provided by giving 10 percent glucose in saline intravenously every 6 hours. Sulfanilamide was given subcutaneously at intervals, maintaining a blood level between 6.25 and 8 mg. per 100 cc.

Course.—His temperature dropped by lysis and on June 17, 5 days after admission, it remained normal. During this time he kept clearing his throat and expectorating large quantities of pure pus and at times would vomit purulent material. Mirror laryngoscopy at this time revealed pools of creamy yellow pus in the pyriform sinuses. The quantity of pus indicated a cellulitis of the esophageal wall or the possibility of an abscess that had ruptured and was draining into the esophagus. His general condition at this time was greatly improved and his chief complaint was hunger and thirst. X-ray at this time revealed no evidence of mediastinal abscess and both lungs were clear. The denture was still in the same location. On June 19, 7 days after

admission, his general condition being good and his temperature normal, it was felt that the denture could be removed with safety.

PLATE 21



THE DENTURE AFTER REMOVAL. NATURAL SIZE.

The decision to perform a gastrotomy and remove the foreign body by retrograde esophagoscopy was made for the following reasons:

1. The recent trauma to the upper end of the esophagus followed by a severe infection seemed to contraindicate further instrumental trauma by ordinary esophagoscopy.

2. The position and shape of the denture indicated that before it could be withdrawn upward it would have to be turned completely around. Its size and the sharp projections on the side made a version within the esophagus inadvisable, thus necessitating its being forced into the stomach before turning it around.

3. To cut the denture in two was out of the question because the attempt was made on a similar one which the patient had, and it could not even be identified with a heavy shears.

4. Since the diaphragmatic pinchcock was larger than the one at the level of the cricopharyngeus, which it had already passed, it was felt that it could be drawn downward without turning and passed through a gastrotomy incision with less trauma and serious consequences.

Operation.—On June 19, 1942, under spinal anesthesia, a short left rectus, muscle-splitting incision was made, the stomach was brought up into the wound and held firm by means of traction sutures. A short incision (about 1 inch long), in the direction of the long axis, was made in the anterior wall of the stomach. The contents were then aspirated and it was washed out with saline. The abdominal wound was completely isolated with packs and the patient redraped leaving only the small portion of the stomach exposed and held out through the incision by means of the guy sutures. An esophagoscope was then inserted through the incision. Inspection was made somewhat difficult due to a constant pouring of thick pus from the esophagus. This was overcome and the cardiac orifice discovered by the simple expedient of gently exploring with and following up an esophageal aspirator under direct vision. The denture was located about 3 inches above the diaphragmatic pinchcock. At this location the walls of the esophagus appeared normal and uninjured and pus was seen continually flowing down from above. The denture to the left of the tooth was grasped with a forceps and held tightly against the end of the esophagus. This caused it to rotate slightly making the sharp serrated edge of the denture trail. The denture and the esophagoscope were then removed together with considerable ease and no damage to the mucosa. The packs and drapes were removed and fresh ones applied and the gastrotomy wound was then closed with two layers of number 1 chromic catgut and covered with a portion of omentum. Six grams of sulfanilamide powder was spread about intraperitoneally. Four grams of sulfanilamide was placed in the abdominal wall incision which was closed in layers with no drainage. The patient was in good condition and experienced no shock.

Postoperative course.—The following morning (June 20) the patient carefully swallowed a duodenal drainage tube passed through his nose. This was connected with a Wangenstein suction apparatus. Suction was applied 2 hours on and 2 hours off. One ounce of sterile water was permitted every hour by mouth and fluids and glucose continued intravenously. Sulfanilamide was continued by hypodermoclysis. Smears and culture of the pus taken from the esophagus revealed streptococcus hemolyticus predominating along with some streptococcus viridans. Sulfanilamide was discontinued and sodium sulfathiazole was given intravenously. His temperature arose to 102° F. the day following operation and by the third day was normal. It has remained normal since then. On the third post-operative day 1 ounce each of orange juice, tomato juice, and broth was given through the duodenal tube every 2 hours. This was well tolerated and it was increased to every hour and milk was added. The duodenal tube was removed on the sixth postoperative day and small amounts of liquids by mouth were permitted frequently. The diet was gradually increased from that time on.

Results.—The abdominal wound healed by first intention and the patient was allowed up on the fourteenth postoperative day. Three weeks postoperatively he was given barium and an x-ray examination of the esophagus was made. Deglutition was prompt and peristalsis was normal. There was no evidence of narrowing or constriction of the esophagus.

COARCTATION OF THE AORTA DISCOVERED THROUGH PHOTOFLUOROSCOPIC FINDINGS¹

By JAMES J. SHORT, Lieutenant Commander, Medical Corps, United States Navy Reserve, and ELMER M. CLAIBORNE, Lieutenant Commander, Medical Corps, United States Naval Reserve

The value of the photofluoroscopic technic as a means of eliminating unfit candidates for military service is daily being emphasized. At the Parris Island Marine Barracks hundreds of potential invalids have thereby been detected at their first examination on arrival. The types of cases thus culled out are predominantly pulmonary and cardiac.

An illustrative case in the latter category is here described. This proved to be coarctation of the aorta and is reported not only to denote the value of the photofluoroscopic technic but also to place on record another case of this relatively rare condition.

CASE REPORT

History.—A. T. McK., a marine recruit, age 20 years, was ordered to report to the hospital for study because inspection of his 35-mm. photofluoroscopic film showed left ventricular enlargement. Further full-sized x-ray films confirmed a definite enlargement of the left ventricle, suggesting hypertension. The aortic knob was unusually small, however, and there was a somewhat indefinite notching of the inferior margins of the ribs posteriorly, which suggested the possibility of erosion by the intercostal arteries and led to a diagnosis of aortic coarctation (fig. 1). The patient was hospitalized for clinical study.

The patient had no physical complaints except occasional sensations of pressure in the head and of heart palpitation. Prior to enlistment he had taken care of horses and done much riding without discomfort. His endurance was good.

Five months previously he had been thrown from a horse. Two doctors who examined him for injuries had discovered hypertension and had made a spinal fluid examination, the results of which were unknown to the patient. He had then been advised to submit to a "gland operation" for malignant hypertension, but had refused. Chest x-ray and electrocardiogram had not been made at that time. Five years previously he had been rejected for a swimming team because of hypertension.

Family history.—His father had died at the age of 45 in a railroad accident. His mother was alive and well at 60. Three brothers were alive and well and one had died by accident. Two sisters were alive and well.

Physical examination.—Examination revealed a well developed, athletic type of young man apparently in the best of health. Head and neck were normal. Chest was somewhat funnel shaped over the sternum. Lungs were negative by physical examination and x-ray. Blood pressure in the brachial artery was 172/80 before exercise and 190/74 after. The pulse was 80 with regular sinus rhythm. The heart was definitely enlarged to the left. At the cardiac apex and over the precordium there was a split first sound followed by a high-

¹ Received for publication June 3, 1942.

fixed, prolonged diastolic murmur with point of maximal intensity at the left margin of the sternum. The liver and spleen were not enlarged and the kidneys were not palpated. The extremities were normal, without edema and the reflexes were also normal.

An outstanding feature of the case was the abnormal peripheral circulation as evidenced by the changes in peripheral arterial pulsations. The radial and brachial pulsations were full and bounding; there were marked pulsations in the neck with definite systolic thrills, more marked on the right. Intercostal artery pulsations were palpable but not visible down to the level of the fifth dorsal vertebra. However no pulsation could be detected by palpation in the abdominal aorta even with good relaxation, or in the femoral or popliteal arteries. A very faint pulsation could be felt in the dorsalis pedis and posterior tibial arteries. A faint pulsation could be obtained in the popliteals by the use of sphygmomanometer and stethoscope, and the blood pressure at this point was found to be 94/62. This stands in marked contrast to the blood pressure of 172/80 found in the upper extremities, and is considered as pathognomonic. Normally blood pressure in the lower extremities exceeds that in the upper.

Laboratory findings.—A complete blood count, Kuhn test, and urinalysis were normal.

Electrocardiographic findings.—The electrocardiogram showed signs of myocardial damage as evidenced by slurred QRS complexes in leads I and III and inverted T waves in leads II and III. The electrical axis was normal.

Diagnosis.—Coarctation of the aorta, aortic insufficiency with myocardial damage.

DISCUSSION

The condition of adult coarctation of the aorta has been thoroughly described by Abbott (1) in a compilation of 200 case records. This article sheds much light upon the collateral circulation which develops in this condition. The extreme rarity of aortic coarctation is indicated by the experience of Dr. George Houck (2) who at the Massachusetts General Hospital found only 2 cases in a series of 5,000 autopsies.

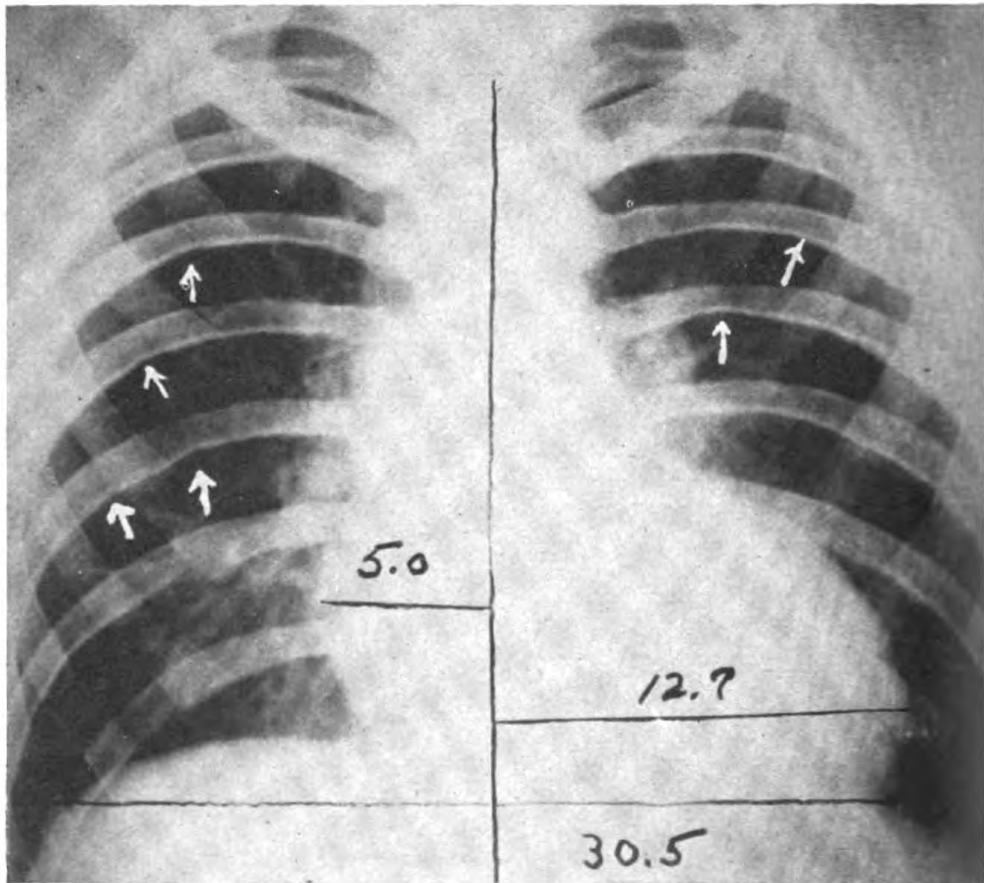
It has been demonstrated that the constriction is usually found at the insertion of the ductus arteriosus just opposite or below the origin of the left subclavian artery. This constriction is produced externally by an annular thickening of the wall, having the effect of a ligature, and internally by a diaphragm or septum formed of the inner coats of the aorta. In approximately 10 percent of cases the ductus is patent. Occasionally the ligamentum arteriosum produces a "traction aneurysm" which ruptures (3).

The degree of stenosis varies from a slight constriction to a complete atresia. In the series of 200 cases reported by Abbott approximately 23 percent showed complete atresia, while 23 percent showed moderate and 54 percent extreme stenosis.

Other commonly associated anomalies are abnormal origin of arteries from the aortic arch and bicuspid aortic valves. The latter defect occurred in 25 percent of the 200 cases already mentioned. A small proportion show hypoplasia of the arterial system as a whole.

As might be anticipated, a large percentage of such cases develop a dilatation of the ascending aorta which varies from a slight enlargement to a definite aneurysm which may rupture into the pericardium. Branches from the arch may likewise become dilated. Atheromatosis is frequently pronounced in the great vessels subjected to such decided hypertensive strain, which confirms the view of Virchow and Aschoff that a mechanical factor enters into the production of this condition. Seventy-five percent of cases show left ventricular hypertrophy and dilatation.

PLATE 22



ARROWS INDICATE EROSION (NOTCHING) OF LOWER MARGIN OF RIBS.

Perhaps the most interesting phenomenon in adult cases of aortic coarctation is the extensive development of collateral circulation without which the subject could not long survive. This is intricate and somewhat complicated. The major routes by which blood is shunted past the constricted area to the lower portions of the body is by way of the superior intercostal arteries which arise from the subclavians and the first aortic intercostals which spring from the aorta just below the constriction; by way of the posterior scapu-

lar, interscapular and subscapular arteries piercing the intercostal spaces posteriorly and pouring the blood coming to them from the subclavians into the second to fourth intercostals, often forming huge trunks which are palpable but not visible; and by way of the internal mammary arteries through the intercostals to the descending aorta.

Lewis (4) states that the condition is usually unrecognized during life. The electrocardiogram usually shows left ventricular preponderance in his experience. White (5) states that the diagnosis can be easily made if one bears in mind the possibility of this congenital anomaly, especially when hypertension is found in a child or young adult. The absence or diminution of pulsation in the arteries of the lower extremities with full or increased pulsations in those of the upper should arouse suspicion, while intercostal pulsations, notching of the ribs, and diminished blood pressure in the lower extremities practically establishes the diagnosis.

SUMMARY

1. A case of adult coarctation of the aorta in a recruit of 20 years has been described.
2. The condition was complicated by aortic insufficiency and possible myocardial damage.
3. A brief discussion of the pathology and essential features of aortic coarctation have been included.
4. The value of the routine photofluoroscopic technic is emphasized.

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ANOMALOUS ORIGIN OF LEFT CORONARY ARTERY¹

A CASE REPORT

By JOHN C. RUDDOCK, Commander, Medical Corps, United States Naval Reserve,
and CHARLES C. STEHLY, Captain, Medical Corps, United States Army

Congenital absence of one or the other coronary artery appears to be a very rare anomaly in man. Especially is this so when it satisfies

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Hyrtil's postulate that one artery really supplies the whole heart, and the anomaly is not merely a matter of common aortic orifice of the two arteries or an unusual origin of one or the other artery (misplaced *anlage*).

Krumbhaar and Ehrich divide the reported cases into three groups:

1. Cases of absent right coronary artery which comply with Hyrtil's postulate.
2. Cases of absent left coronary artery, where left side of heart is supplied by one or two apparent branches of the right coronary.
3. Miscellaneous unclassified cases.

The cause of death as listed in these cases according to this classification is as follows:

Group 1:

- Absent right coronary.
- Endocarditis.
- Apoplexy.
- Pneumonia.
- Carcinomatosis.
- Pulmonary embolism.

Group 2:

- Absent left coronary.
- Endocarditis.
- Acute nephritis.
- Pneumonia.
- Carcinomatosis.
- Unknown.

Group 3:

- Miscellaneous.
- Unknown.
- Coronary obstruction.

The case reported is one of misplaced *anlage* and falls under group classification 3. This case demonstrates that life is compatible with anomalous origins of the coronary arteries without demonstrable pathological changes in the myocardium.

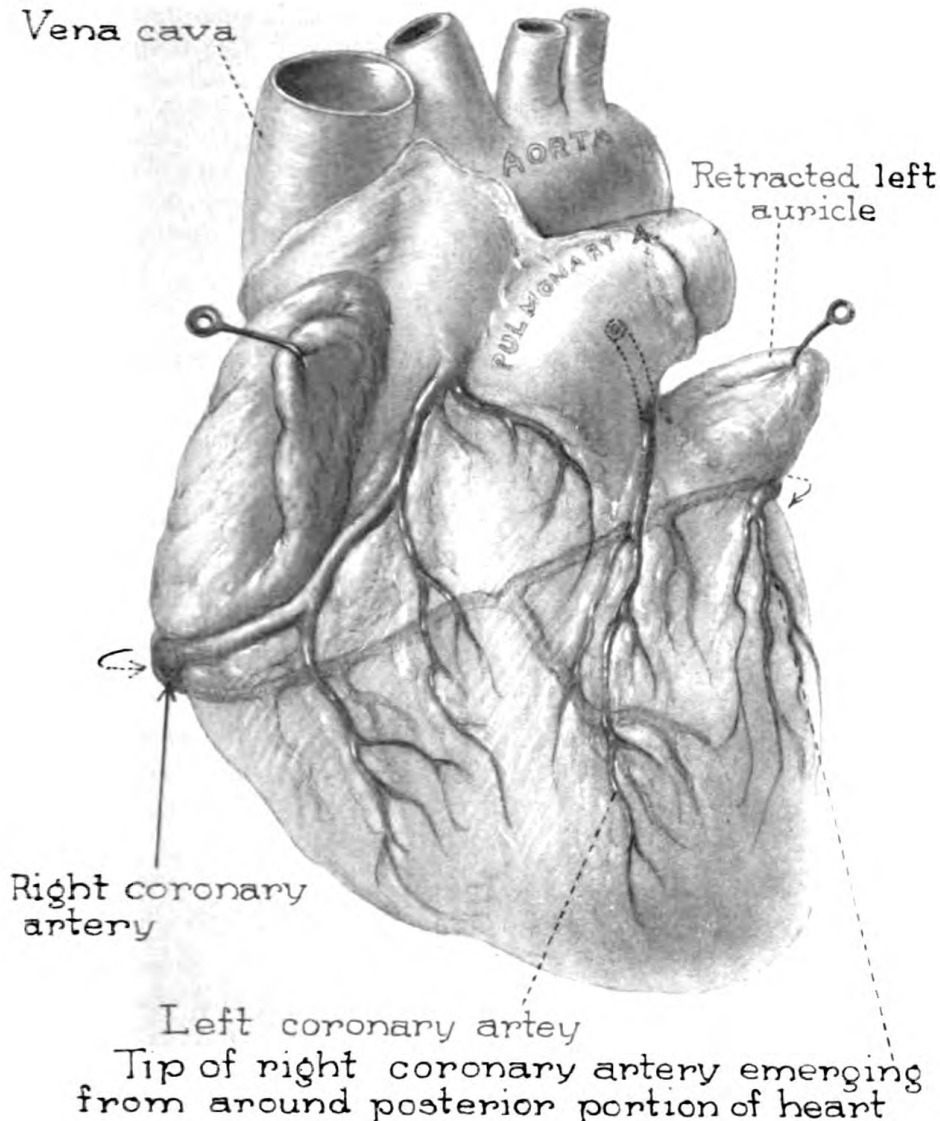
CASE REPORT

History.—A 30-year-old, married white male, was found dead by a fellow worker. The deceased was a laborer and his various tasks were of an arduous nature. The deceased was seen ten minutes prior to his exodus and he appeared normal and he was performing his work as usual. There was no history of any physical complaints. His wife stated that her husband had always possessed good health and he worked steadily. There is no record of any physical examination, primarily because the deceased had never had occasion to seek medical advice.

Necropsy.—A postmortem examination revealed the following findings: The liver was normal in size and color. The kidneys were normal. There was no evidence of congestion or inflammation in the lungs. The heart weighed 310 grams. The left and right ventricle walls were of normal thickness. The chambers of both ventricles were normally proportioned in size. All of the valves were normal, i. e., thin and permitted perfect anatomical closure. There

was no evidence of arteriosclerosis. The endocardium was normal. Cut surface of the myocardium showed no evidence of degeneration, inflammation or scarring. The right coronary artery arose at its usual site from the anterior aortic sinus (figure 1). The mouth of the opening measured 8 mm. in diameter.

PLATE 23

Harper Sweet

1. SHOWING ORIGIN AND DISTRIBUTION OF LEFT AND RIGHT CORONARY ARTERIES.

The stoma was immediately divided by a septum into a large and small opening. The smaller opening marked the beginning of a branch of the right coronary artery, 1.5 mm. in diameter, which course was distributed over the upper portion of the right ventricle and communicated with branches of the left anterior descending coronary artery. The larger opening continued as a

dilated right coronary, 5 mm. in diameter, which ran forward between the root of the pulmonary artery and the auricle of the right antrum, coursed along the auriculoventricular groove giving off branches to the right ventricle and a large posterior descending branch which occupied the sulcus between the left and right ventricles and continued to the apex to communicate with the anterior descending branch of the left coronary. The main right coronary artery continued in the auriculoventricular groove, giving off a large branch to the mid-antero-posterior aspect of the left ventricle, and terminated as a communicating branch with a small left circumflex artery.

The left coronary artery arose from the posterior wall of the pulmonary artery approximately 25 mm. distal to the cusps of the pulmonic valve. The artery passed anteriorly and downward between the auricle of the left atrium and the pulmonary artery for a distance of 20 mm. where a small branch, corresponding to the left circumflex artery was given off. This vessel communicated with the terminal branch of the right circumflex artery over the basal portion of the anterior surface of the left ventricle. The main left coronary artery (approximately 5.5 mm. in diameter) continued downward in the inter-ventricular sulcus, supplying branches of the right descending coronary artery.

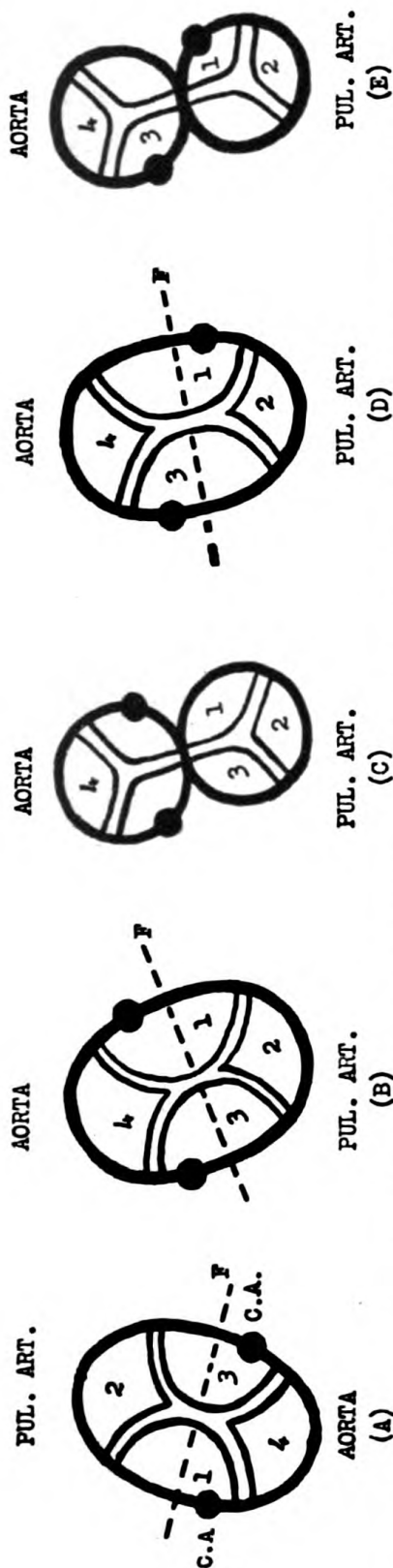
DISCUSSION

The anomalous origin of either the left or right coronary artery or both from the pulmonary artery is a rare congenital finding and thought by most authors to be incompatible with life.

The pathogenesis of origin of the left coronary artery from the pulmonary artery is difficult to explain. In the embryological development of the aorta and pulmonary artery, the malposition of the *unlage* of the coronary arteries might be a probable explanation of such an anomaly (figure 3).

A review of the literature reveals the following reports of anomalous origin of either coronary artery from the pulmonary artery and various comments. Bland (1) believes that the origin of the left coronary artery from the pulmonary artery is incompatible with life beyond the first year. He believes that the extensive changes in the heart muscle are due to: First, inadequate nourishment and low oxygen saturation of the blood; and second, low pressure in the coronary artery arising from the pulmonary artery. We believe the above conclusions are relative factors and vary with the extent of distribution of the anomalous left coronary artery and the compensatory reaction of the right coronary artery. Maude Abbott (2) reports 10 cases of the origin of the left coronary artery from the pulmonary artery in a summary of 1,000 congenital hearts. Sanes and Kenny (3) report a case 3 months of age in which the left coronary artery arose from the pulmonary artery. Autopsy revealed a markedly enlarged heart with extensive fibrosis, necrosis, and calcification of the myocardium. It is their opinion that deficiency of oxygen is the important pathogenic factor and is responsible for the change noted. Grayzel and Tennant (4) report a case of a white female infant, 10 hours' old, that appeared to be doing well and then died suddenly.

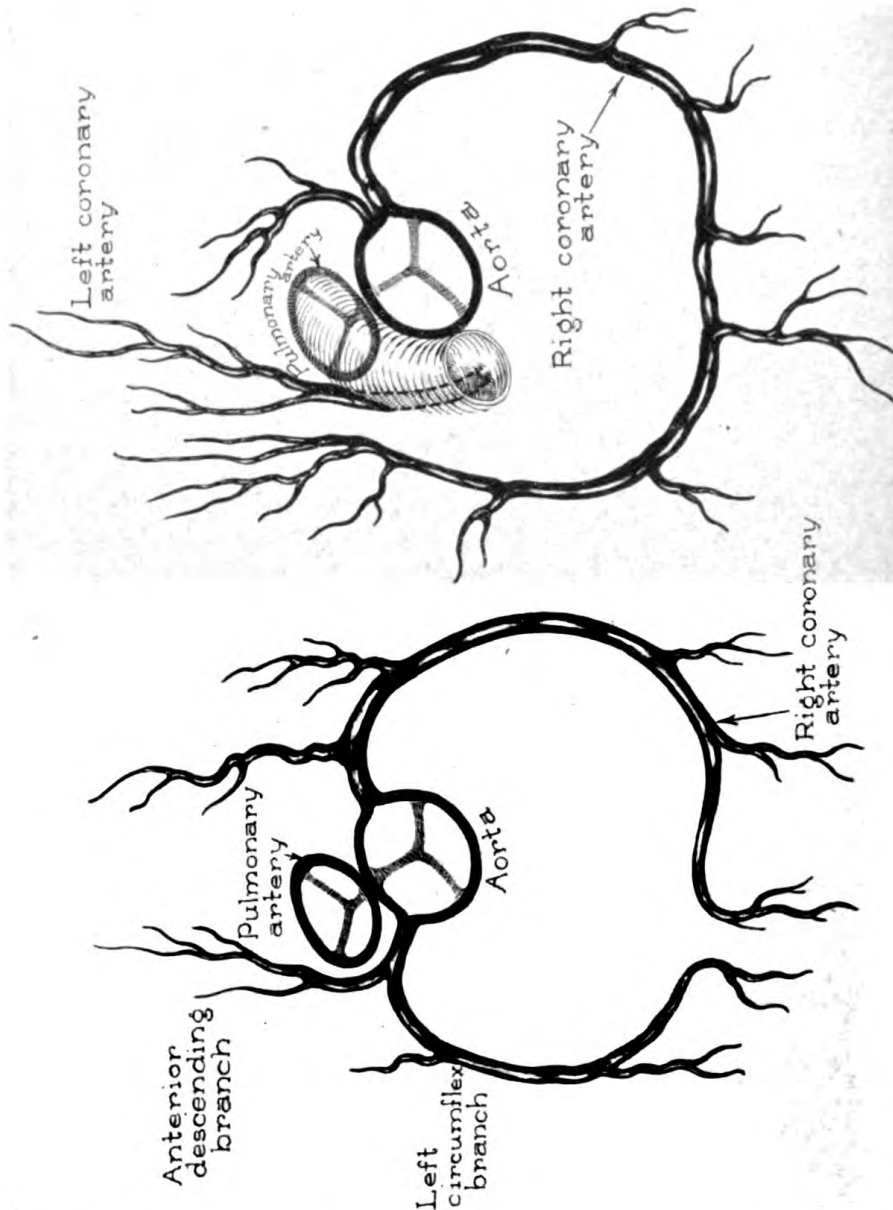
PLATE 24



2. SCHEMATIC DRAWING REPRESENTING ANLAGE OF AORTA, PULMONARY ARTERY AND CORONARY ARTERIES: (A) NORMAL POSITION OF AORTA AND PULMONARY ARTERY (C. A.) ORIFICES OF CORONARY ARTERIES BEFORE ROTATION; (B) NORMAL POSITION AFTER ROTATION; (C) NORMAL POSITION AORTA, PULMONARY ARTERY AND CORONARY ARTERIES AFTER FUSION AND DIVISION ALONG AXIS (F); (D) POSITION OF CORONARY ARTERIES AFTER ROTATION (CASE); (E) POSITION OF CORONARY ARTERIES AFTER FUSION AND DIVISION (CASE). (FRAZER: MANUAL OF EMBRYOLOGY.)

Autopsy revealed that the coronary arteries arose from the **sinus** of Valsalva behind the two posterior cusps of the pulmonic valve. Bortsch and Smekal (5) made a review of cases of origin of **either** coronary artery from the pulmonary artery and the following are quoted: "(1906) a 2-day-old child with left coronary artery arising

PLATE 25



3. SCHEMATIC DRAWING SHOWING (LEFT) NORMAL ORIGIN AND DISTRIBUTION OF CORONARY ARTERIES AS COMPARED WITH CASE REPORTED (RIGHT).

from pulmonary artery; Von Konslantinowitsch (1906), a 2-day-old girl; Heitzman (1917) a 3½-month-old child; Moncheberg (1914) describes a case, 30 years of age in which right coronary artery arose from the right sinus of Valsalva of the pulmonary artery; Scholte

(1921) a 2½-month-old girl; Krumbhaar (1924) a 12-month-old girl; Schley (1925) a 61-year-old man with the right coronary artery originating from the pulmonary artery; Bortsch and Smekal (1930) a 3-month-old child with the left coronary artery arising from the pulmonary artery; and Sanes and Kenny (1932) a 3-month-old girl." Chown and Schwalm (6) describe a case in which the left coronary artery arose from the pulmonary artery, resulting in death from myocardial failure at the age of 5 months. Richter (7) states that few hearts are known in which a coronary artery arises from the pulmonary artery. He describes a case of Kockel wherein the left coronary artery originated from the pulmonary artery without evidence of myocardial degeneration. He also quotes a case of Schley of a 58-year-old man, laborer and soldier, with no evidence of myocardial fibrosis. Marianne Limbourg (8) quotes a case of Hockel (1934) of a 38-year-old man found dead wherein the left coronary artery arose from the pulmonary artery with fibrosis and scarring of the myocardium. Limbourg (1936) also reports a case 10 days old with the left and right coronary artery arising between the left and right pulmonary valve. Barnard (9) reports a case of a 23-month-old female with the left coronary artery arising from the pulmonary artery. Dietrich (10) reports a case of a 53-year-old laborer with the left coronary artery arising from the pulmonary artery. Death was attributed to generalized circulatory failure with extensive generalized arteriosclerosis.

Most of the cases reported expired before reaching 12 months of age. It is rare for an individual with an anomalous origin of either coronary artery from the pulmonary artery to sustain life into adulthood. Five cases recorded in the literature and the sixth (case reported here) of individuals reaching adulthood and old age, indicate that such an anomaly is not incompatible with life, but may offer a normal cardiac function for many years only to be revealed at autopsy by some not closely related degenerative or pathologic process.

The lack of fibrosis and myocardial scarring noted in our case may be attributed to a compensatory arterial supply of the right coronary artery as demonstrated by: First, the dilatation of the right coronary artery; and second, the accessory distribution of the distal end of the right coronary artery beyond the interventricular sulcus and into the left ventricular musculature, the area normally supplied by the circumflex branch of the left coronary artery (figure 2).

The musculature supplied by the anomalous left coronary artery differed in no respect from any other portion of myocardium. This would indicate, per se, that the pressure in the pulmonary artery is sufficient to establish a near normal circulation and that the O₂ saturation of the blood in the pulmonary artery is sufficient to maintain

a normal cardiac function providing, as in our case, the area being supplied is small.

SUMMARY AND CONCLUSION

1. A case report of anomalous origin of left coronary artery from pulmonary artery in an adult 30 years of age.

2. The misplaced *anlage* of either coronary artery is probably the most plausible explanation of the anomalous origin of either coronary artery from the pulmonary artery.

3. The extent of myocardial scarring and fibrosis resulting from the anomalous origin of the left coronary artery is thought to depend upon, (a) Extent of distribution of the anomalous artery and (b) the compensatory distribution of the right coronary artery.

4. Most cases of anomalous origin of either left or right coronary arteries, or both, from the pulmonary artery succumb prior to two years of age. The anomalous origin of the left coronary artery from the pulmonary artery is not incompatible with life.

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DIAPHRAGMATIC HERNIA¹**A CASE REPORT**

By EDWIN M. JAMESON, Lieutenant Commander, Medical Corps,
United States Naval Reserve

Although the literature on diaphragmatic hernias contains records of several thousand cases, the condition is sufficiently uncommon in everyday surgical practice to warrant a report of an incarcerated herniation of the stomach and omentum through a defect in the diaphragm with cure following operation.

According to Foster (1) hernias through the diaphragm were found once in about 18,000 roentgen-ray examinations at the Mayo Clinic, three times in 15,000 examinations in the United States General Hospital No. 8, and there were only 6 cases in about 24,000 roentgen-ray examinations done at the Waterbury Hospital over a period of 6 years. In other words, the frequency of this condition is somewhere around one case in every 5,700 x-ray examinations.

A large number of varieties, types, and degrees of these hernias have been recognized and attempts made at classification based on anatomy, embryology, etiology, and contents although clinical differentiation is impossible. A convenient clinical grouping would divide them into those of traumatic origin and those in which trauma played no part. The traumatic group would be further subdivided into those caused by direct and those caused by indirect injury to the chest or abdomen and the non-traumatic group into herniations due to congenital or postnatally acquired defects in the diaphragm. It is our belief that the case to be reported falls into the non-traumatic, postnatally acquired group in spite of the suggestive past medical history.

The recent literature and facts regarding incidence, symptoms, physical signs, diagnosis, prognosis, classification, treatment, and technic of operation were summarized in 1938 by Bowen (2).

CASE REPORT

H. C. C., shipfitter, third class, U. S. N., age 22, was brought to this station by plane from the advanced base where he was stationed, on May 10, 1942. His chief complaints on admission were pain in the left upper quadrant of the abdomen and in the left chest with repeated vomiting, at about 20-minute intervals, of an ounce or two of white sputumlike fluid.

He stated that for the past four months he had noted left upper abdominal discomfort after a full meal. Five days before admission the discomfort had been somewhat more marked than usual but he felt perfectly well on the day of onset of the present illness until he began the evening meal. After drinking a bowl of soup he felt a distinct "snap" in the epigastrium that was followed by severe cramplike pain and vomiting. The vomitus at first con-

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sisted of the soup that he had taken and then of the frothy sputumlike material noted on admission. The pain was described as sharp and stabbing and was localized in the left upper quadrant from which it radiated into the left flank and chest. There had been no bowel movement or expulsion of gas per rectum since the onset of the attack although he had been given repeated enemas.

Intravenous fluids were given the day before admission and an unsuccessful attempt made to pass a Wangensteen tube to the stomach. The highest temperature recorded before admission was 100.4° F. and the white count was 11,850.

It is of interest to note, and much to their credit, that the correct diagnosis was made on the basis of the clinical findings alone by the medical officers at the advanced base.

There was nothing in the previous medical history of interest except a note that on September 21, 1941, the patient had received a stab wound of the left chest posteriorly at the level of the tenth rib. According to the record made at that time there was no evidence of lung injury or signs of pneumothorax.

Physical examination on admission revealed a well-nourished and well-developed white male lying in bed with the thighs flexed on the abdomen and complaining of severe pain in the left upper quadrant and left chest. TPR 100.4°-120-22; blood pressure 134/70. The skin was of good color, warm and moist; there was no evidence of dehydration and his general condition appeared to be satisfactory.

The chest was dull to percussion on the left side below the 8th rib posteriorly and there was complete absence of breath sounds over this area although a loud friction rub was audible. The cicatrix of an old wound was noted at the level of the 10th rib in the posterior axillary line and the heart was displaced well over to the right.

The abdomen was flat and there was exquisite tenderness and boardlike rigidity in the left upper quadrant. No masses or organs were palpable.

The leukocyte count was 17,300 with 77 percent segmented forms and 4 bands. The urine was normal with a specific gravity of 1.025.

The patient was taken to the x-ray laboratory and examined fluoroscopically by Dr. I. J. Warmolts who submitted the following report:

"The lower three-quarters of the left chest is occupied by a large circular shadow consisting of half fluid and half air. Fluoroscopically a dancing fluid level is seen above and another below the level of the diaphragm, although this structure could not clearly be identified. The heart, mediastinum, trachea and esophagus are displaced markedly to the right, and when a mouthful of barium was given the latter structure is noted to be markedly dilated. The stomach is hugely dilated and contains a large amount of fluid. There is no motion, on respiration, of the upper limit of the previously described circular shadow in the left thorax and the mediastinum shows little shift on respiration and no paradoxical excursions. The lower limit of the esophagus is sharply twisted upon itself on its long axis about 180° producing considerable stenosis." (Figure 1.)

On return to bed a stomach tube was carefully introduced and 1,500 cc. of dark brown, odorless fluid evacuated. Lavage until a clear return was obtained was done with considerable relief.

On the morning of May 11 a second lavage was done and approximately 500 cc. of chocolate-colored fluid containing barium was obtained. Roentgen-ray examination then showed that:

PLATE 26



HERNIATED, WIDELY DILATED STOMACH.

"The heart and mediastinum have shifted back to approximately normal position. The fluid level and the upper limit of the circular shadow are at the same levels as on the first examination but the contents of the shadow have obviously been greatly decreased in volume.

The left lower lobe is completely atelectatic and represented by a dense shadow about the size of a lemon. There is also atelectasis of the elevated base of the upper lobe. The stomach is greatly decreased in size following lavage and still contains barium. No barium has entered the small bowel.

"A glass of barium was administered and the large circular shadow in the thorax is identified as being the stomach. Only one fluid level is present at this time. The films taken demonstrate the stomach to be rotated 180° on its long axis and displaced high into the thorax so that its greater curvature is directed superiorly. The cardiac end is rotated at the junction with the esophagus producing moderate stenosis. From the cardia the stomach proceeds to the left and then forward so that the pars media is almost in contact with the anterior thoracic wall. From there the stomach swings downward and then posteriorly so that the conical pyloric end is directed sharply backward and downward. At no time did any barium pass through the pyloric sphincter into the duodenum, which is obviously under great tension."

In order that the left leaf of the diaphragm might be demonstrated, a pneumoperitoneum was given. Films taken in the left lateral reclining and left lateral semireclining position showed the diaphragm at approximately its normal level. "The entire stomach is demonstrated as lying above the diaphragm and enters the thorax through a large defect in its medial portion. A considerable amount of fluid, estimated at about 400 cc., is present in the pleural cavity above the diaphragm and to the left of the stomach. The left kidney is noted to occupy a low position in the left flank; the spleen is in its normal position and the liver is not apparently displaced."

The stomach tube was again passed on the evening of May 11 and a small amount of chocolate-colored fluid evacuated. When an attempt was made to introduce the tube still farther, bright red blood was obtained and the tube was withdrawn. On the morning of May 12 a Miller-Abbott tube was passed without difficulty and 800 cc. of chocolate-colored, rather foul-smelling fluid obtained. This fluid did not, however, suggest feces.

Under pontocaine-procaine spinal anesthesia the abdomen was opened through a left pararectus incision extending from the costal margin to a point just below the umbilicus. Exploration of the abdominal contents showed that the stomach and most of the omentum had herniated into the left chest through an orifice approximately 5 cm. in diameter that was located anterolaterally to the aortic hiatus. This ring had a hard almost cartilaginous edge and presented a distinct ligamentum-like band on its outer border. The hernia was quite adherent to the ring except at the posteromedial border where a finger could be introduced. The adhesions at the ring were carefully separated and the ring enlarged by incising its anterolateral margin for approximately one inch. The ligament-like band was then clamped and divided. By careful blunt dissection with the finger through the ring the hernia was separated from its surrounding structures in the chest and by gentle traction pulled into the abdomen. After some four-fifths of the stomach had been delivered it was found that the remaining portion was tensely dilated forming a balloon about the size of a lemon so that it was necessary to enlarge the

ring still further. Following this last maneuver the stomach and omentum were delivered without difficulty and the diaphragmatic defect exposed. It was noted that as soon as traction on the stomach was released it tended to slip back into the thorax. Two walnut-sized hemorrhagic lymph nodes were noted at the cardiac-esophageal angle and were excised. The defect in the diaphragm was then repaired with mattress sutures of No. 2 chromic catgut.

During the course of the operation oxygen under 5 mm. Hg. pressure was given intermittently. An infusion of 10 percent glucose in saline, started when the skin incision was being made, was supplemented during the course of the operation with 250 cc. of plasma.

The postoperative course was remarkably smooth. Carbon dioxide-oxygen inhalations were started at half hour intervals as soon as the patient returned to bed and were continued for 48 hours. On the evening of the first postoperative day the temperature rose to 104° F. with a pulse of 120 and respirations of 35. Physical examination showed a pneumothorax on the left with displacement of the heart to the right. Thinking that some of the patient's discomfort might be caused by a tension pneumothorax, an attempt was made to aspirate some of the air from the chest. When he was placed in an oxygen tent the respiratory difficulty became much less marked.

There was no alarming distention although the Miller-Abbott tube could not be passed beyond the pylorus. Prostigmine methylsulfate was given at three-hour intervals until the fourth day when a liquid diet was started. The temperature remained around 100° F. with a falling pulse rate for the first 5 days and there was evidence that the left lung was expanding satisfactorily. After the fifth postoperative day the TPR observations remained normal.

The sutures were removed on the 9th postoperative day and the incision found to have healed per primum. The patient was allowed out of bed on the 21st day.

On June 3, 1942 (24 days after operation), a gastro-intestinal series was reported as follows:

"The esophagus remains slightly dilated and the abdominal esophagus is elongated; the cardia of the stomach is likewise elongated. The left lobe of the liver occupies a position to the left of the normal and is interposed between the diaphragm and the cardia, depressing the latter. The stomach lies transversely and is no longer dilated. The duodenum is elongated, slightly narrow and somewhat redundant. The jejunum and the proximal ileum is disposed in the right upper quadrant instead of the lower left. The jejunum is considerably dilated and the mucosa is edematous. The remainder of the bowel is in its usual location. At 4 hours the barium meal is in its usual position and the stomach is empty. There is retained barium which has refluxed into a slightly dilated common bile duct. Examination of the colon after a barium enema shows no abnormalities."

The author wishes to express his indebtedness to Lt. Col. H. M. Bergamini (MC) U. S. A., Capt. Irving Marshall (MC) U. S. A., and Lt. Comdr. I. J. Warmolts (MC) U. S. N., to whose cooperation it is felt that the successful outcome of this case is largely due.

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AN UNUSUAL CASE OF COMPRESSED-AIR ILLNESS¹

By WM. S. FRANCIS, Lieutenant, Medical Corps, United States Navy

Compressed-air illness is the term now generally adopted for that malady also known as caisson disease, bends, diver's palsy, etc. When an individual is subjected to increased air pressure for a period of time, this increase in pressure causes the amount of gases in solution in the blood to be increased in proportion to their partial pressures. As the blood circulates through the body, the difference in partial pressures of the gases in the blood and the tissues causes the tissues to become supersaturated. Nitrogen, being an inert gas, is not utilized, so that the tissues are supersaturated with nitrogen. In slow decompression, this difference in partial pressure is reversed; the nitrogen is taken up from the tissues by the blood stream and carried to the lungs where it is exhaled. If decompression is too rapid, the gases coming from the supersaturated tissues cannot be adequately carried away by the blood stream without bubble formation in the blood stream itself. These bubbles may block the circulation or otherwise injure tissues according to the location.

In recent years, many facts have come to light on the physiologic processes involved in the cause and treatment of compressed air illness. There are three factors involved in the production of this condition:

1. The degree of air pressure to which exposed.
2. The time of exposure to this pressure.
3. The length of time taken in coming back to atmospheric pressure.

Such factors as age, systemic disease, fatness of the individual, fatigue, etc., have a lesser but important bearing on the etiology.

Treatment of this condition can be expressed in one word: Recompression. This effects a reduction in size of the bubble and consequent reabsorption and also probably by absorption and expulsion of the bubble as a whole, aided by the fact that reduction in size from recompression produces a movable bubble which is carried to the lungs for expulsion.

At the Deep Sea Diving School, 13 men were put into the decompression chamber during routine training for divers, and subjected to an air pressure of 122 pounds or the amount corresponding to 275 feet of water. All were apparently normal physically before entering the chamber and none experienced any physical difficulties as the pressure was being increased. The full amount of pressure was effected in 5 minutes and the men were at that depth for 4 more minutes, when the ascent by stage decompression was started in

¹ Received for publication April 2, 1942.

accordance with the standard decompression tables. Pressure from this depth was lowered at the rate of 25 feet per minute until the first stop at 20 feet (9 pounds) was reached. After 20 minutes decompression at this depth, ascent to 10 feet was made where the stop was for 37 minutes, and then ascent was made to the surface.

About 30 minutes following his emergence from the chamber to normal atmospheric pressure, one of the men complained of an unusual "funny" feeling. There was no pain or dimness or blurring of vision. He stated that he felt "light headed" and his manner was one of apprehensiveness. The pupils were equally dilated. The pulse rate was 60 and regular. He picked up a newspaper and was amazed to find he could see the print clearly but the printed words had absolutely no meaning to him. There was no hemianopsia, paresthesia, or motor weakness. The intelligence was preserved. Upon arriving at these findings and realizing the emergency of the condition, a more detailed examination was not warranted and he was immediately put back into the chamber. At 75 pounds pressure his signs and symptoms entirely disappeared. The pressure was increased to 89 pounds (corresponding to 200 feet) where he was kept for 30 minutes and then the pressure was lowered to 90 feet. Stage decompression was then carried out in accordance with the method of Yarbrough and Behnke. Decompression was completed as follows:

Depth:	Time at stop
90 feet.....	7 minutes
80 feet.....	22 minutes
70 feet.....	24 minutes

Changed from air to oxygen at 60 feet, and decompression completed as follows:

Depth:	Time at stop
60 feet.....	26 minutes
50 feet.....	30 minutes
40 feet.....	34 minutes

Time from 40 feet to surface—15 minutes. Upon reaching the surface he was still normal and no residuals developed.

SUMMARY

A case of compressed air illness characterized by optical alexia, or word blindness, caused by a gas bubble at the angular gyrus of the brain, is presented. Complete relief by recompression was effected.

A REACTION TO DRIED POOLED HUMAN PLASMA ¹

By T. McKEAN DOWNS, Commander, Medical Corps, United States Naval Reserve

The general feeling is that reactions do not occur with dried pooled human plasma (1) (2) (3) such as is issued to the services for use in the field. Indeed, the descriptive literature furnished with the outfits provided specifically states that no typing or cross matching is required.

¹ Received for publication July 7, 1942.

Dried and redissolved plasma was used in large amounts in treatment of the wounded resulting from the surprise attack that precipitated the war. Inquiry among medical officers who treated these patients has resulted in finding a case of reaction to its use.

Lt. Joseph E. Nunes, Medical Corps, United States Naval Reserve, writes me:

Through my own experience and in my investigation among other doctors, I have been able to find only one reaction to blood plasma, which occurred on the evening of the 7th of December 1941, at the Pearl Harbor Naval Hospital. At the time the patient had a slight reaction with mild chilling, but not violent enough even to be logged. The next morning the patient had an elevated temperature of 102° F. but by that same afternoon the temperature had returned to normal.

A letter from Lt. L. E. Rector, Medical Corps, United States Naval Reserve, exemplifies the more usual experience. He says:

I may state that my experience with the administration of dried plasma to severe burn cases from December 7 to 9, 1941, was limited to some 20 patients. No reactions were recognized. I heard of no reactions being experienced on other wards, but cannot say definitely there was none.

Reaction to plasma can occur, therefore, and the purpose of this report is to draw attention to this possibility. My present location, not near a medical library, has made exhaustive search of the literature impracticable. Yet in addition to my own case I have found a report by Polayes and Squillace (4) describing a very serious reaction due to the use of dried pooled plasma.

CASE REPORT

G. W. F., white male, age 20 years, was admitted to a naval hospital on the evening of March 28, 1942, via stretcher. He was quite sick, and was complaining of severe pain in the right upper abdominal quadrant. He had been confined in the sickbay of his ship for a week, being given morphine frequently. There had been a somewhat similar attack 1 year previously. There was no history of jaundice. On examination there was rigidity of the right rectus muscle, and a mass was present in the gallbladder area. The temperature and white count were moderately elevated. The clinical impression was cholelithiasis, and expectant treatment was instituted. A scout film of the abdomen showed no radiopaque calculi.

By the next morning the patient was worse, the mass was larger and more tender, and the leukocyte count was rising. It was felt that there was now an empyema of the gallbladder, and an emergency operation was done.

At operation hydrops of the gallbladder was found, without stones. Cholecystostomy was done, a rubber tissue drain was inserted into the peritoneal cavity, a lymph node was removed for study, and the abdomen was closed.

Postoperatively the patient did poorly. Acute dilatation of the stomach developed. Continuous suction drainage was instituted and intravenous feeding of 5 percent glucose solution in saline had to be depended upon. After a week, the superficial portion of the wound broke open, with no signs of granulation tissue or attempted healing. At this time the blood count was normal,

and the blood chlorides distinctly low (396 mg. percent). The hospital was not equipped to determine the plasma protein concentration, but it was considered probably low. Accordingly the case was thought to be a proper one for the use of plasma.

The dried plasma was regenerated strictly in accordance with directions. No preliminary tests for compatibility were done, as they were considered unnecessary.

I quote from the ward surgeon's report:

"This patient was given a 250 cc. injection of dried plasma at 4:10 p. m., April 5, 1942. Approximately 4 cc. of the plasma was injected subcutaneously into the right arm during the effort to insert the needle into the vein. The plasma was given quite slowly and approximately 5 minutes from the beginning of the injection the patient developed a slight hacking cough which increased in severity. The next thing noticed was a large wheal developing about the area of the injection. Following this we noticed a blue discoloration of the lips, pulse rate began to increase from his normal rate of 86, dyspnea developed, and there was swelling of the face and eyelids. The pulse rate reached 148, and began to take on irregular rhythm. The patient stated that he 'felt terrible and ached all over,' and that the skin of his entire body felt 'like sandpaper and quite itchy all over.'

"The plasma injection was not discontinued, but the patient was given one-half cc. of 1:1,000 solution of epinephrine hydrochloride and the condition tended to subside after about 20 minutes. He was given an additional one-half cc. of epinephrine. The plasma injection was completed in 35 minutes. Following this, 1,000 cc. of 5 percent glucose in saline was given and within an hour practically all signs of the plasma reaction had disappeared. Patient's temperature did not rise during the reaction."

Following this reaction, the patient's condition seemed unchanged, so two blood transfusions of 500 cc. each were given on the following 2 days. The patient at once began to improve, his appetite returned, his wound began to heal, and on my detachment from the hospital he was recovering normally.

It is easy to criticise the management of the ward surgeon in this case in continuing the injection after the onset of untoward symptoms, namely, the cough. Fortunately the incompatibility was apparently not extreme, or the outcome might have been fatal. None of the regenerated plasma remained, so there was no opportunity to do any laboratory tests afterward. It is not known, therefore, if the fault lay in the preparation of the particular lot of plasma used, or if it were a true incompatibility between the patient and plasma.

In the case reported by Polayes and Squillace, cross-matching of the patient's blood with the plasma solution showed agglutination of red cells to an extent that would have contraindicated the use of the plasma if it had been known in advance.

Before my detachment from the hospital I had directed that except in emergency no dried plasma should be given until it had been cross matched with the patient's blood. Of course the incidence of severe reactions is small enough so that in emergency this possibility could be ignored and the plasma used without testing.

SUMMARY

A case of moderately severe reaction to the use of dried and regenerated pooled human plasma is recorded, an unpublished case is mentioned, and reference is made to another similar case in the literature.

It is my belief that for the present, except in emergency, preliminary tests of compatibility should be made before using regenerated pooled plasma.

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PROGRESSIVE FACIAL HEMIATROPHY¹

REPORT OF A CASE

By O. HUGH FULCHER, Lieutenant Commander, Medical Corps, United States Naval Reserve, and W. ZEPH LANE, Lieutenant, junior grade, Medical Corps, United States Navy

Hemiatrophy of the face represents a rather disturbing condition of obscure etiology for which the present methods of treatment have been disappointing. The definition given by Osler (1) appears classical:

A rare affection characterized by progressive wasting of the bones and soft tissues of one side of the face. The wasting is sharply limited at the midline and the appearance of the patient is very remarkable, the face looking as if made up from two halves of different persons.

Wolfe and Weber (2) reviewed the world literature on this condition in 1938 and found that 476 cases had been reported. Since then there have been about a dozen cases added. One is impressed by the fact that more than 34 percent of these patients gave histories of trauma preceding the onset of symptoms. Another group gave histories of infections, tumors, congenital cysts of the neck, and bony anomalies of the spinal vertebrae and of the face which could produce trauma to the nervous system and thereby alter certain functions. Yet another group of patients appear to present a vaso-

¹ Received for publication August 14, 1942.

-pastic component or an endarteritis simulating Raynaud's or Buerger's disease, respectively, and for this reason some authors have advocated cervical sympathectomy during the early course of the disease before the development of the stage of fibrosis, strangulation and destruction of capillaries and arterioles.

Kazanjian and Sturgis (3) have performed plastic procedures on one patient using autogenous transplants of bone, fascia, and skin, which have not proved satisfactory because the cosmetic results are short-lived due to the involvement of the transplanted tissues in the progressive process of atrophy.

CASE REPORT

W. F. D., the patient, was a white, married, enlisted man, age 30 years, who was admitted to the hospital on March 24, 1942, with the complaint of pain, muscular twitching, and shrinkage of the right side of the face, associated with watering and tenderness of the right eye. These symptoms and signs had developed over a period of about 6 years.

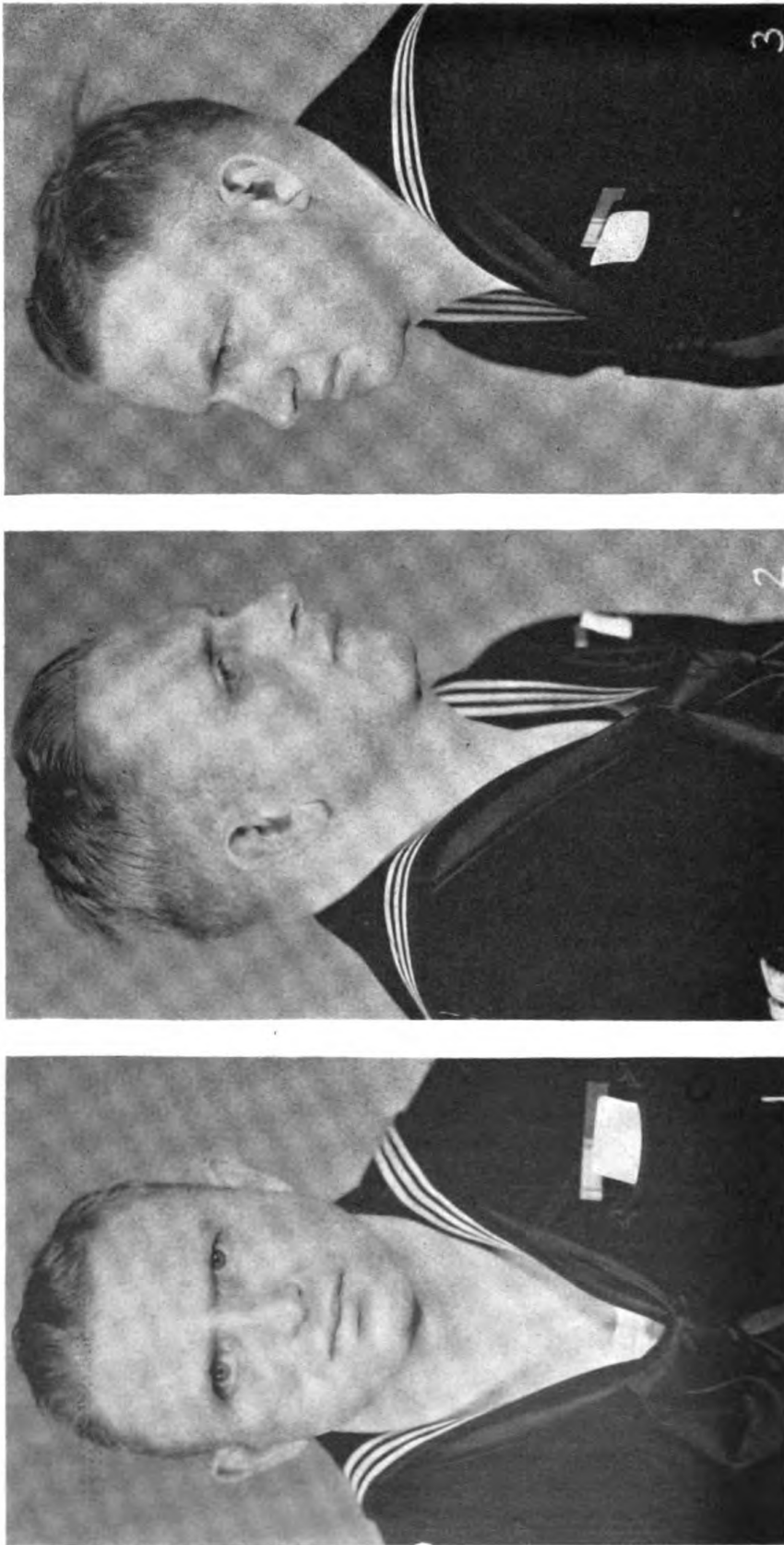
The patient had the usual childhood diseases and had his tonsils and adenoids removed at the age of 8 years. He had enjoyed excellent health until 1932, when he developed a pneumonia from which he made a complete recovery. He had a chancroid infection in 1934, which responded to treatment, and a small sebaceous cyst which was excised from the left mastoid region in 1939.

In 1933 he struck the right parieto-occipital region of his head on a gun shield. He was momentarily dazed and noted soon thereafter that a bluish swelling had developed over the right eye which disappeared in a few days. A few months later he observed a fine white scar extending from the lateral margin of the right forehead at the hairline, to the inner margin of the right eye and down across the midportion of the right cheek.

This white line remained stationary and he enjoyed good health until 1936 when the left zygomatic bone was fractured during a boxing bout. This fracture was surgically reduced by the open method. About 6 months later he observed a wasting of the right cheek, associated with twitching and sharp cramplike pain in the muscles of the right face. These symptoms increased gradually until about a year ago, when the wasting and the muscular twitchings became more rapid, and there developed soreness and watering of the right eye. The muscular contractions occasionally caused biting of the cheek. The change from a warm room to chilly air would frequently cause uncontrollable spasm. He could obtain some relief by massage and application of heat. During the period from 1937 to 1941 the patient stated that he frequently experienced a feeling of weight on the top and right side of his head as though "a hand were resting on the scalp."

Examination revealed a well developed and well nourished white man of about 30 years who was cooperative and presented a rather striking appearance (figs. 1, 2, and 3). The right side of the face was grossly distorted by loss of the soft tissues of the right cheek, periorbital region, and right half of the nose. The right side of the tongue and uvula were atrophied. There were mild fibrillations of the temporal, orbicularis oris and supraorbital muscles. The masseter muscles and the bone appeared only slightly involved. The right eyelid could not be closed completely which appeared to be due to loss of orbital fat rather than to muscular paralysis. On one occasion the masseter muscles went into spasm after effort and he complained of cramplike pain in this region.

PLATE 27



1. THE ATROPHY OF THE RIGHT SIDE OF THE FACE IS SHARPLY LIMITED AT THE MIDLINE.—2. NOTE THE LINE OF DEPRESSION EXTENDING FROM THE HAIRLINE OF RIGHT FOREHEAD TO MEDIAL MARGIN OF EYE AND DOWNWARD ACROSS RIGHT CHEEK.—3. THE NORMAL SIDE OF THE FACE SCARCELY APPEARS TO BE THAT OF THE SAME PERSON.

There was a definite conjunctivitis on the right. There was a depression about 1 cm. in width and about 3 cm. long in the long axis of the scalp in the right frontoparietal region which involved the soft tissues only. There was a visible depression in the soft tissues extending from the lateral margin of the right forehead at the hairline, diagonally downward to the inner canthus of the right eye, then downward and laterally across the right cheek to the angle of the mandible. Along this area the soft tissue was not adherent to the bone and no underlying bony defect could be detected. The tone and strength of the muscles of the right side of the face approximated those of the left, except that the right side of the tongue was definitely weaker. There was a diminution of sensation to light touch and pinprick over the central portion of the right forehead and in the midportion of the right cheek. The growth of hair, perspiration, oily secretions, temperature and pigment of the skin appeared normal and similar to that of the left side of the face. There was no Horner's syndrome; the pupils were equal and reacted to light and accommodation. The fundi appeared normal and all other clinical neurological studies revealed only normal findings.

There was nothing unusual about the mental reaction of this patient. He was somewhat embarrassed about his appearance because strangers stared at him and because friends were constantly asking him questions. He was much worried over the rapid wasting of the right side of the face and about the future course.

Temperature ranged from 98° to 99° F. The pulse was 80 beats to the minute, and the blood pressure was 118/76. Encephalography revealed no filling defects or distortion of the ventricular system. The subarachnoid air pattern appeared normal and the cranium revealed no bony defect. The serological test (Kahn) was negative for syphilis. The spinal fluid showed a specific gravity of 1.018, a total protein of 10 mg. percent, 1 cell to the cubic mm., and negative Kahn, Wassermann and colloidal gold reactions. A complete blood count and urinalysis revealed only normal findings.

COMMENT

This patient presented a rather unusual picture of right facial hemiatrophy which appeared to involve the subcutaneous tissue and to some extent the muscles, especially those of the right side of the tongue. The etiology appears to be due to trauma and the fibrillary twitchings would indicate an involvement of the homologue of the anterior horn cells of the spinal cord. The treatment is very unsatisfactory and consists principally of care of the right eye and heat and massage to the right side of the face. The atrophy will probably be progressive and may result in greater involvement of the muscles and bones of the right side of the face.

Wolfe and Weber (2), Werba (4), and other authors have emphasized that the disturbance of the sympathetic nervous system represented the physiological basis for the production of hemiatrophy of the face. Our studies of this patient do not appear to corroborate their opinion as all the known functions of the sympathetic nervous system appear to be intact in the involved area.

An analysis of the cases reported in the literature reveals the prevalence of trauma or conditions that produce trauma to the nervous system, as a possible etiological factor. In the case reported one is impressed by the onset of symptoms following the head injuries, indicating the latter as the causative factor. It appears that hemiatrophy of the face may represent a rare post-traumatic sequel of a cranio-cerebral injury.

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A COMPARATIVE STUDY OF RESULTS OF SULFONAMIDES IN TREATMENT OF GONORRHEA¹

By W. R. GRISWOLD, Lieutenant, Medical Corps, United States Navy

During a recent 18-day visit of this vessel at a foreign port there occurred 31 cases of gonorrhea among the personnel—a rate of 29.1 per 1,000.

In spite of repeated lectures by the medical officer and the showing of venereal hygiene motion pictures, only one man in this group used a prophylactic following exposure.

These men were given ambulatory treatment with sulfonamides; there being no local treatments given. Sixteen patients were given sulfathiazole and 15 were given sulfapyridine; the dosage in each case being grams 4 stat. and gram 1 four times a day for 7 days. Equal doses of sodium bicarbonate were given. A total of 31 grams of sulfonamides was given each patient during the initial 7-day period.

The men were cautioned to drink large quantities of water, to avoid heavy work, and to keep hands clean and away from eyes.

White blood counts, differentials and urinalyses were done on alternate days throughout the period of sulfonamide therapy.

The average white blood count at onset of treatment was 6,125; the highest being 12,400 and the lowest 5,300. At cessation of treatment the average white blood count was 5,029. There were no cases on whom therapy had to be discontinued because of lowered white blood count or disturbed differential counts, nor were there any

¹ Received for publication August 5, 1942.

adverse reactions necessitating discontinuance of the drug. One man had a generalized maculo-papular rash about 4 days after cessation of treatment. It soon cleared up with rest in bed and forced fluids. There were three instances of nausea and vomiting which responded to increased fluid intake and taking medication on a full stomach after meals.

The discharge stopped in the sulfathiazole group in an average of 1.8 days after beginning treatment. One stopped in 18 hours and one lasted 3 days. In the sulfapyridine group the discharge ceased after an average of 5.8 days; one in 2 days and one in 16 days.

Two-glass urine tests were done at frequent intervals and at end of 7 days' therapy all the sulfathiazole group presented clear urine in both glasses. In the sulfapyridine group only two presented clear urines at end of 7 days.

Stained prostate smears were examined 1 week following cessation of therapy. In the sulfathiazole group all smears were negative at this time and remained so for 3 successive weeks. In the sulfapyridine group 8 smears were negative 1 week after cessation of therapy and 7 were positive for gram-negative intracellular diplococci. These 7 cases have been placed at bed rest and are under treatment with sulfathiazole.

Stained urinary sediment smears were done on all patients one month following cessation of treatment with the following results: Sulfathiazole group—all negative; sulfapyridine group—8 were negative.

There were no gonorrheal complications in the sulfathiazole group; there was one case of gonorrheal arthritis in the sulfapyridine group, and he is at present in bed under treatment with sulfathiazole and physical therapy.

As far as a comparison of the efficiency of the two drugs is concerned, it would appear that sulfathiazole is definitely superior to sulfapyridine. In the former group there were 100 percent cures and in the latter 53.3 percent.

Serological tests for syphilis were done on all patients one month after onset of treatment and all were reported negative.

EXTRA-URETHRAL PENILE GONOCOCCAL INFECTION¹

REPORT OF A CASE

By C. E. HARNER, Commander, Medical Corps, United States Naval Reserve,
and R. E. KELLY, Lieutenant, Medical Corps, United State Naval Reserve

Gonorrhea has a predilection for mucous, serous, and synovial membranes. In the vast majority of cases in the male it involves only the anterior and posterior urethra.

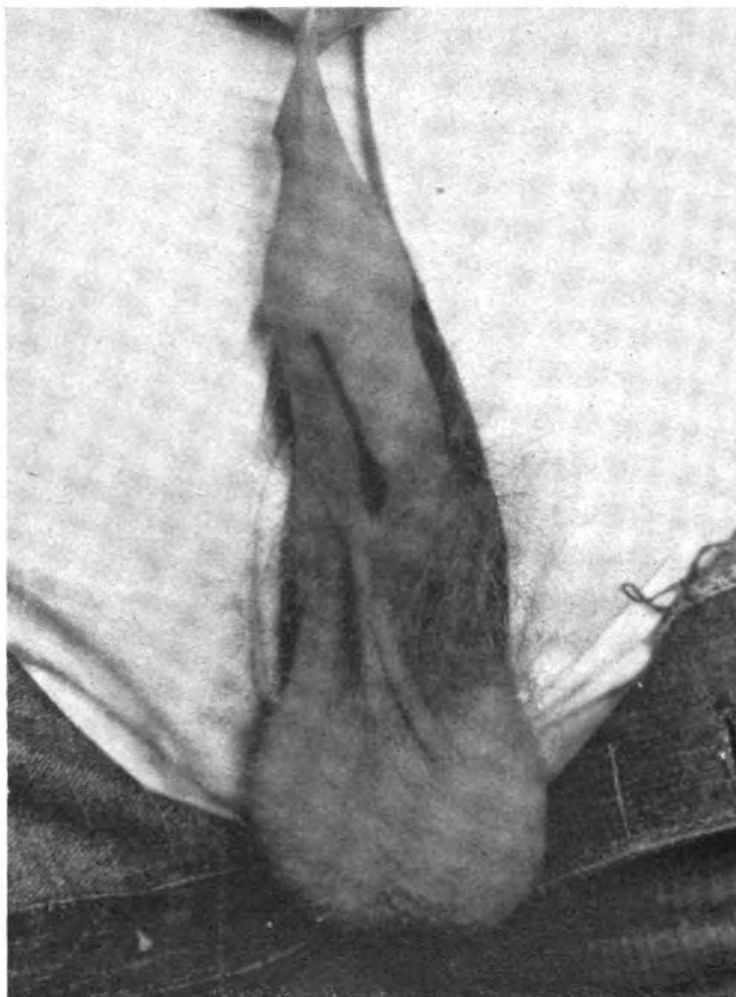
¹ Received for publication July 6, 1942.

We wish to report a case of gonococcal infection limited to a fistulous tract in the skin of the shaft of the penis, being primary in that location and not involving the urethra.

CASE REPORT

R. C. C., a white male, age 20 years, was exposed to venereal infection by intercourse. He stated that he applied "alcohol" liberally to his penis and

PLATE 28



GONOCOCCAL INFECTION IN FISTULOUS TRACT

returned to the ship 2 hours later. Here he was given the routine prophylaxis consisting of tincture of green soap wash, $\frac{1}{4}$ percent protargol irrigation of urethra, held 5 minutes, and calomel ointment 33 percent (sanitube) applied in the urethra and massaged onto the penis, scrotum, and thighs.

He did not notice any symptoms until 6 days later when there was a mild irritation of the skin of the under surface of the penis. On the following day he observed some secretion appearing from "somewhere under the penis" and he presented himself to the sick bay on the 8th day following exposure.

Examination revealed a linear reddened area along the median raphe, extending from a point several centimeters from the proximal end of the penis

to within 3 centimeters of the frenum where it terminated in a minute opening. From this opening a bead of pus could be stripped. The entire tract appeared as no more than a small flattened fold of reddened skin. It seemed to exist within the deeper layers of the skin rather than under the skin.

There was no secretion from the urethra and the color of the mucosa of the meatus and urethra was normal. There was no communication between the tract and the urethra (as demonstrated several days later by injection with methylene blue).

Smear from the secretion from the tract was positive for the gonococcus, showing many intra- and extra-cellular gram-negative diplococci of typical morphology.

Treatment was begun immediately and consisted only of sulfathiazole gram 1 q. i. d. by mouth. No local treatment other than cleanliness was used. The discharge diminished daily and entirely disappeared on the fifth day. All treatment was discontinued on the eighth day and the patient was discharged as cured.

No history of congenital deformity such as hypospadias was obtained but the patient gave an indefinite and hazy history of a slight wound of the penis at the age of 5 years when a pig snapped at the organ causing a slight tear of the skin.

COMMENT

A primary gonococcal infection of the skin of the shaft of the penis is considered of sufficient interest to warrant placing on record.

SULFATHIAZOLE FEVER

By J. E. WALKER, Lieutenant Commander, Medical Corps, United States Naval Reserve, and LEWIS GUNTHER, Lieutenant Commander, Medical Corps, United States Naval Reserve.

The extensive use of sulfathiazole warrants reporting these observations on the undesirable and serious reactions resulting from its use.

Chills and fever ranging to 105° F., and maculopapular eruptions have been observed in 8 patients. The reactions occasioned serious concern before the true nature of the cause of the fever was determined. In some instances the diagnosis was far from obvious and the severity of the illness, the high fever and the low blood concentrations of sulfathiazole influenced us to increase the dose of the drug in an effort to obtain a more desirable blood level.

Symptoms, as a rule, began abruptly, with a rapid rise in temperature, or with a chill followed by an abrupt peak of fever. The temperature curve was hectic in character, in a pattern not unlike that of a bacteremia, septicemia, or of lateral sinus thrombosis. Headache, malaise, generalized pains, profound exhaustion, and occasionally, nausea and vomiting were noted as the predominating symptoms. In 4 of the 8 patients the diagnosis was made when a characteristic maculopapular rash appeared. The maculopapular areas had rather defi-

nite borders and were slightly tender. They disappeared within 24 to 36 hours after the drug was discontinued, leaving no stain, pigmentation, or scar. The rash was distributed on the extensor surfaces of the extremities and over bony prominences.

Laboratory determinations of blood sulfathiazole concentrations were of no definite benefit or aid in establishing a diagnosis, and showed no relationship to the clinical findings. The values ranged from "trace" to 9.6 mg. percent at the peak of the fever.

A depression of the bone marrow activity was constant. Urinary findings were no different from those usually observed during the course of sulfathiazole therapy.

Lyons¹ reported a series of "drug fevers" resulting from sulfathiazole administration. His observations were not unlike our own. He noted, however that individuals previously treated with sulfathiazole were more susceptible to febrile reactions than those receiving the drug for the first time. In fact, 36 percent of the patients previously treated developed fever when a second course of the drug was given. Approximately 10 percent developed pyrexia during the initial course of treatment. These untoward reactions occurred only in those instances where the drug was continuously administered for a period of 7 days or longer.

He assumed that a sensitization occurred as in the case of other sensitizing substances. All attempts however to demonstrate a sensitization by patch and scratch tests were fruitless.

In our patients one-half were known to have received previous sulfathiazole therapy. In one, more than 12 months had elapsed since the preceding treatment. Two had received treatment within a period of 10 days. Febrile responses developed within 12 to 48 hours after the therapy was started and subsided 12 to 72 hours after it was discontinued. The efficacy of the drug was not seemingly impaired by these reactions; it may have been enhanced by the pyrexia (chart 1).

In two instances sulfadiazine therapy was instituted after sulfathiazole reactions had occurred and no untoward symptoms resulted.² This observation was also made by Lyons in regard to sulfanilamide and sulfapyridine. It is likely therefore that sensitivity to sulfathiazole does not predicate the existence of a sensitization to other members of the sulfonamide group.

CASE REPORTS

Case 1.—Mrs. A. E. was admitted with the diagnosis of an infection following abortion. Sulfathiazole therapy was begun on admission. Thirty grams

¹ Lyons, Richard H., and Balberor, H.; Febrile reactions accompanying the readministration of sulfathiazole. *J. A. M. A.* 118: 955, Mar. 21, 1942.

² The feasibility of substituting sulfadiazine for sulfathiazole has been amply verified by further observations here, since this paper was written.

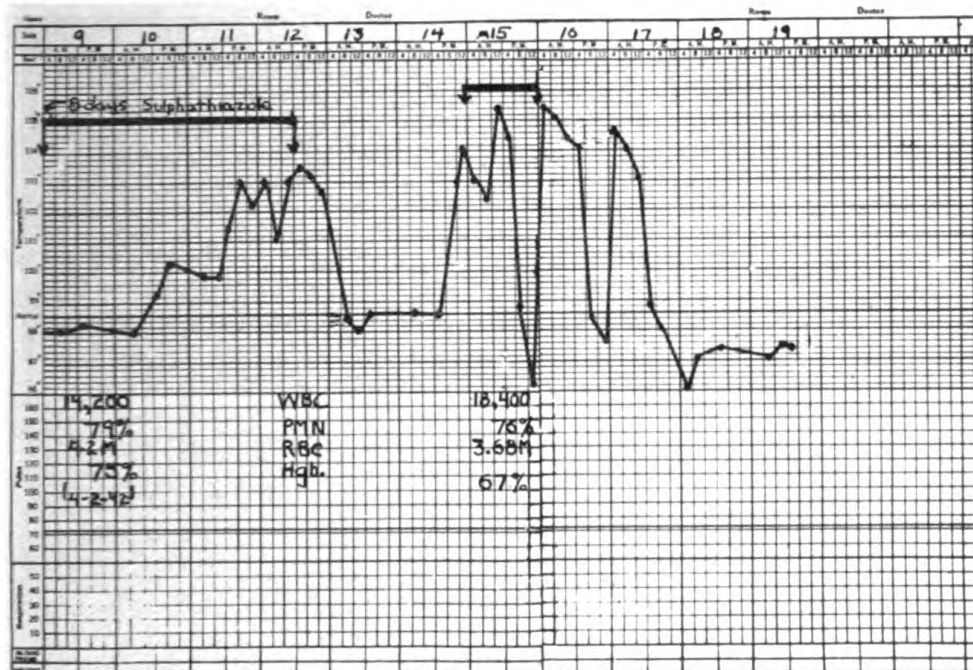


CHART 1. CASE 1.

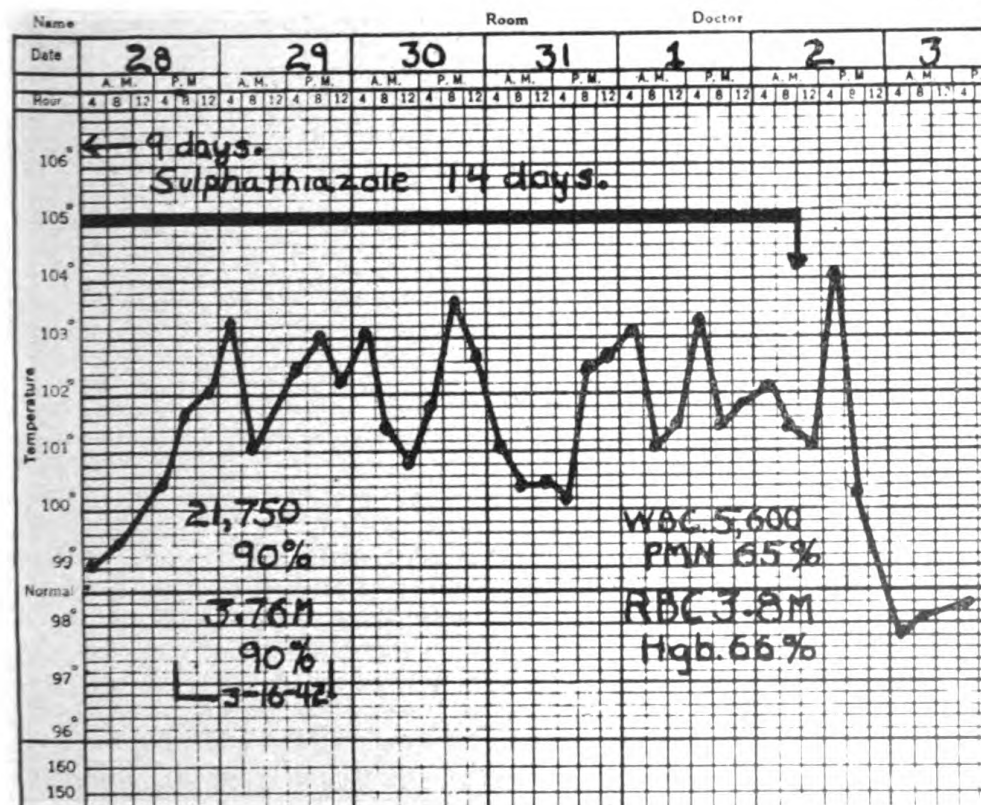


CHART 2. Case 2.

of the drug were administered in 7 days, when the drug was stopped. The average dose was 1 gram every 4 hours. A low-grade fever continued to be manifested and the drug was administered again after an interval of 24 hours. The patient had a chill the following day and the fever rose to 105° F. Thereafter, the chart showed a hectic fever curve (chart 1). The pulse did not swing in proportion to the fever. At the highest peak of fever the sulfathiazole level was only 3.9 mg. percent.

PLATE 31

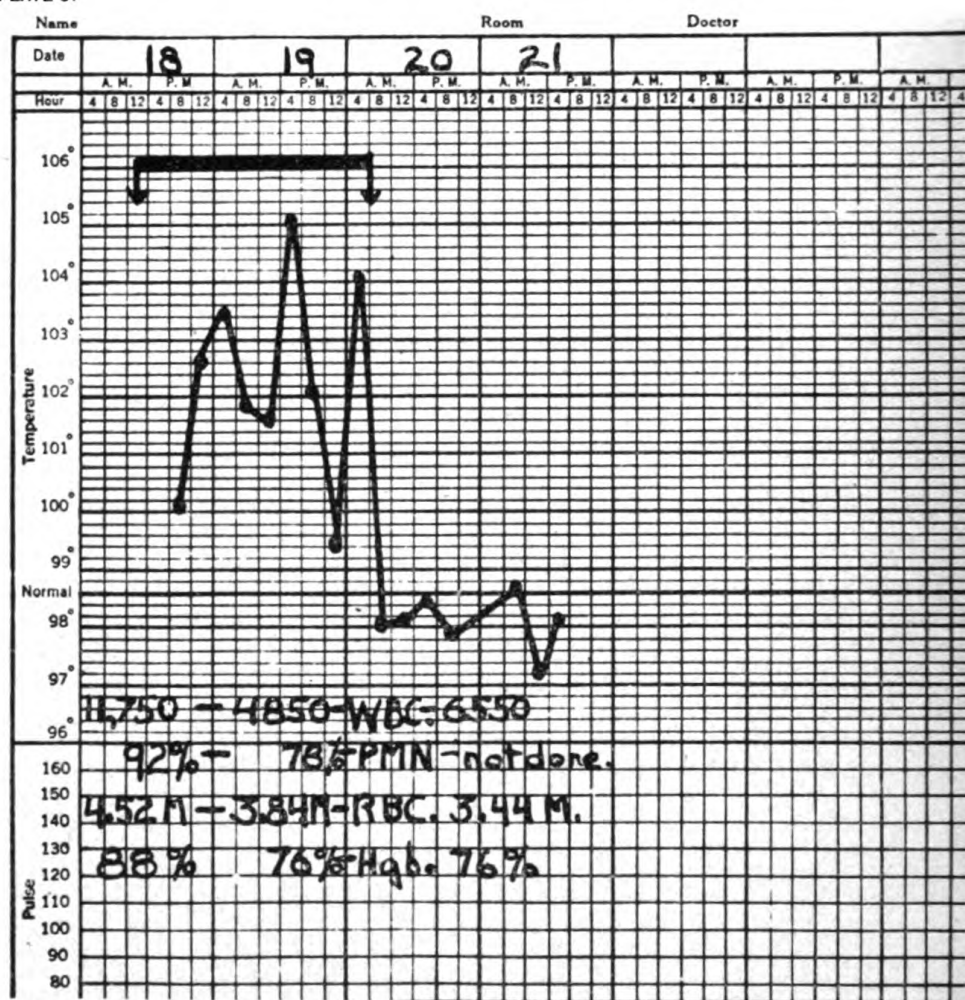


CHART 3. Case 3.

On the 12th day, the medical consultant noted the following:

(a) 12 days of sulfathiazole therapy, consisting of an initial period of therapy of 7 days, a 24-hour interruption, then a second course of treatment.

(b) A depression of the bone marrow involving all elements (table 1). The picture of bone marrow depression became marked 2 days after the drug was discontinued.

On the basis of the hectic fever and a rapid depression of the bone marrow during sulfonamide therapy, a diagnosis of sulfathiazole fever was made and the drug was stopped. The fever promptly subsided.

Case 2.—M. K. suffered a fracture of the mandible in an automobile accident. There was considerable swelling of the soft tissues of the mouth. Sulfathiazole was begun on the 5th day because of a low-grade fever during the preceding 2 days and local swelling of the submaxillary region. The temperature subsided 4 days thereafter, but it was considered advisable to continue the drug because of a "possible osteomyelitis." On the 10th day of sulfathiazole therapy, the patient vomited, and the fever rose to 103.2° F. Thereafter there was an intermittent nausea and vomiting. The fever continued, was of a hectic type, between 103.6° F. and 100.2° F. (chart 2). On the 13th day she had a chill and the fever rose to 104° F. The medical consultant on this day noted:

- (a) 14 days of continuous sulfathiazole therapy.
- (b) 5 days of hectic fever.
- (c) Maculopapular rash of the extensor surfaces of the extremities.

PLATE 32

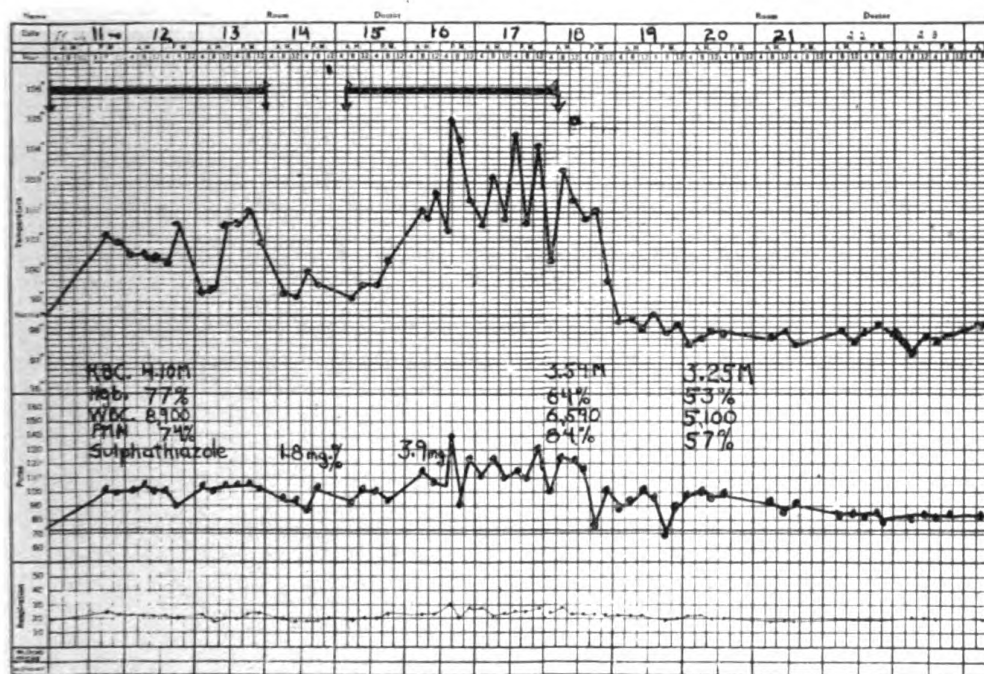


CHART 4. Case 4.

(d) Marked suppression of the bone marrow (table 1.) The drug was stopped. The fever promptly subsided and the rash disappeared after 48 hours.

Case 3.—Mrs. F. was admitted with a furuncle of the finger of 1 week's duration. She showed a lymphangitis of the surrounding area, and red streaks to the regional lymph glands. Sulfathiazole therapy was promptly instituted. The following day she had a chill, the temperature rose to 105° F. (chart 3), and a maculopapular rash appeared on the extensor parts of the legs and thighs. On the second day, the patient continued to have chills. At this point of the illness, serious consideration was given to the possibility of septicemia, cortical renal abscess, or other complications as a cause of the fever. It was noted that there was a suppression of the bone marrow (table 1). A diagnosis of sulfathiazole fever and rash was made and the drug was discontinued. The fever promptly subsided. The rash was almost imperceptible within 24 hours.

It was learned that 1 year before, the patient had developed a rash following sulfathiazole therapy.

Case 4.—A. R. was admitted for an infection of the arm. After 11 days of sulfathiazole therapy he developed a maculopapular rash with a fever of 103° F. The fever was hectic (chart 4). Sulfathiazole therapy was discontinued and the fever promptly subsided.

Three days later he developed an otitis media. The ear drum was incised for drainage. Sulfadiazine therapy was instituted. A complete recovery ensued. The bone marrow suppression after sulfathiazole was minimal, and was not increased by the sulfadiazine therapy (table 1).

The fever chart during the period of the complication stands in contrast with that of the fever from sulfathiazole. Likewise it is to be noted that no further depression of the bone marrow was obtained during the sulfadiazine therapy after the course of sulfathiazole.

TABLE 1.—Laboratory data on the 4 cases

Patient	Hemo- globin Sahli	Erythro- cytes millions	Leuko- cytes	Neutro- phils	Eosino- phils	Baso- phils	Lympho- cytes	Mon- ocytes
A. E.:								
5-12-42.....	77	4.10	8,900	74		0	23	3
5-14-42.....	75	4.15	5,650	81		0	16	2
5-16-42.....	81	4.36	6,000	85	2	0	10	3
5-18-42.....	64	3.50	6,950	84		0	16	
5-19-42.....	69	4.44	4,600	62		0	34	4
5-20-42.....	53	3.25	5,100	57	1	0	39	3
5-21-42.....	56	3.43	6,350	49		0	50	1
M. K.:								
3-16-42.....	90	3.76	21,750	90			8	2
4-1-42.....	66	3.80	5,600	65	2	3	25	5
F.:								
5-18-42.....	88	4.52	11,750	92	1		5	2
5-19-42.....	76	3.84	4,850	78			22	
5-20-42.....	76	3.44	6,550					
A. R.:								
4-2-42.....	75	4.20	14,000	79	2	1	13	5
4-4-42.....	76	4.17	19,500	63			37	
4-15-42.....	67	3.68	18,400	76			23	1

SUMMARY AND CONCLUSIONS

These observations have served to convince us that severe and possibly dangerous febrile reactions may result from sulfathiazole therapy. We feel that the following deductions may be made:

1. Any sudden rise in temperature, or chills and fever, occurring during the course of sulfathiazole therapy should be considered as possibly due to the drug itself.

2. Persistent fever with a depressed leukocyte count with possibly a progressive anemia is sufficient indication to warrant the consideration of sulfathiazole fever and toxicity, and a discontinuance of the drug.

3. The appearance of a maculopapular rash during sulfathiazole therapy should arouse suspicion and when any of the above symptoms and findings are coincidental the drug is probably responsible and should be stopped.

4. The history of previous sulfathiazole therapy accompanied by rash or unexplained febrile reactions should preclude the use of the drug a second time.

5. Known reactions from sulfathiazole administration do not preclude the use of other drugs of the sulfonamide group.

6. In any given instance when sulfathiazole has been previously used, especially for a period of 7 days or longer, presenting the above clinical picture, sulfadiazine becomes the drug of choice.

TINEA VERSICOLOR¹

By WADLEY R. GLENN, Lieutenant, Medical Corps, United States Naval Reserve,
and HUGH HAILEY, Lieutenant, Medical Corps, United States Naval Reserve

Due to the relative frequency of this infection in the spring and summer it is considered worthwhile to call this condition to the attention of medical officers in the dispensaries of the Army and Navy. Its mild contagiousness and the ease with which it has been confused with other skin conditions also prompts this report.

Tinea versicolor, also known as pityriasis versicolor, manifests itself as a fawn-colored, slightly scaly, flat eruption. Usually it is limited to the shoulders, back, neck and upper chest though it may be more extensive. The lesions are apt to change color (versicolor) to a rusty tan or, on sun exposure, to peel leaving bleached scaly spots while the surrounding normal skin is tanned. At times the spots may be dense and reddened similar to measles or sparse and light brown resembling general freckling. In other cases the infection is composed of large plaques some of which are confluent, appearing somewhat like large, light brown, flat birthmarks.

Often pityriasis rosea is confused with tinea versicolor, although the differentiation is not so difficult. The former is characterized by a herald spot or mother patch which develops 10 days to 2 weeks before the general eruption. The individual lesions are oval shaped in line with the direction of the ribs. They are reddened with an elevated margin and a lighter colored central area which is covered with a thin crinkly "cigarette paperlike" scale. Pityriasis rosea is, so far as is known, noninfectious and runs a limited course, while tinea versicolor is infectious and will continue to spread if not treated.

The diagnosis of tinea versicolor can be confirmed by a microscopical examination of the scales from a fawn-colored lesion. The lesion may be scraped with a dull-bladed knife and the scales transferred

¹ Received for publication June 11, 1942.

to a clean glass slide on which have been placed two drops of 20 percent potassium hydroxide. A cover slip is then applied over the preparation. With the high dry lens numbers of clusters of round cell spores can almost immediately be seen along with branching and jointed mycelia (*Microsporon furfur*). The collection of spores in cluster formation is characteristic and confirmatory of the clinical diagnosis.

Tinea versicolor is a persistent and stubborn infection, but cure can be accomplished by perseverance. A variation of treatment is effective: The use of 2 percent iodine for 1 week, then 3 percent salicylic acid in 70 percent alcohol for a second week, followed by 1:10,000 aqueous solution of bichloride of mercury for a third week and a 10 percent solution of sodium thiosulfate for the final week of active treatment. Afterward, daily sunlight exposures are advisable.

Sunlight is to be avoided during the stage of active treatment because uneven tanning is produced by the spots of infection. Daily cleansing with soap and water, followed by liberal sprinklings of borated talcum, should be used indefinitely.

MEDICAL AND SURGICAL DEVICES

AN AMBULATORY TRACTION DEVICE FOR THE TREATMENT OF FRACTURES OF THE CERVICAL SPINE ¹

By F. R. Hook, Captain, Medical Corps, United States Navy, and ROBERT MAZET, Jr., Lieutenant Commander, Medical Corps, United States Naval Reserve

Fractures and fracture-dislocations of the cervical spine have a disconcerting tendency, at times, to recur after reduction if traction is replaced by a collar too soon. This is particularly true in forward dislocations, in crush fractures with dislocation, and in fractures of the laminae.

The method employed to obtain reduction seems to have no influence on this fact. Brookes (1) has ably described the manipulative methods of Taylor and of Walton, both of which have their firm adherents. Corner (3) employs manual reduction with anesthesia. These methods are not without danger of damage to the cord. With these methods the plaster collar is applied as soon as reduction is accomplished.

The more gradual reduction by means of traction applied through a halter has long been in use. Stookey (13) has modified it by using an air mattress with a rolled blanket under the patient's shoulders. Willard and Nicholson (14) utilize the weight of the head itself, with the neck hyperextended over the end of the bed, to obtain reduction. All these methods are uncomfortable, produce spasm of the neck muscles, necessitate constant watchfulness and adjustment, and if prolonged may occasion bedsores and skin necrosis. For these reasons skeletal traction is generally replacing them.

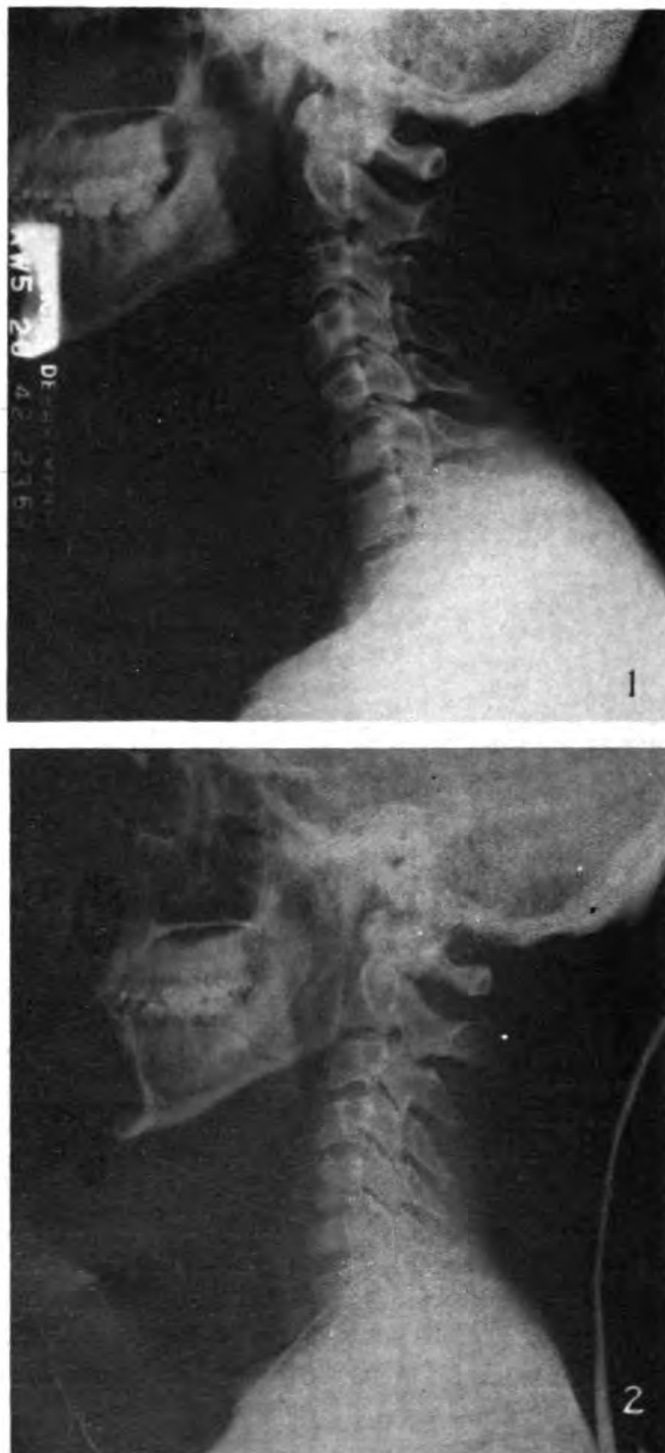
Several types of skeletal traction are in use. The ice tongs of Barton described by Corner (3) and used by Gallie (8) have the disadvantage of protruding out from the sides of the head and prevent free movements of the patient. The same disadvantage pertains to Neubeiser's (12) hooks under the zygomata.

Hoehn (9) and Cone and Turner (2) use wires passed through two holes in either side of the skull.

We have been utilizing the Crutchfield (4)(5)(6)(7) tongs. This method, we believe, is the most comfortable for the patient. The

¹ Received for publication August 5, 1942.

PLATE 33



1. (CASE 1). ON ADMISSION, SHOWING COMPRESSION FRACTURE OF THE 6TH CERVICAL VERTEBRA.—2. (CASE 1). CRUTCHFIELD TONGS IN PLACE, SHOWING REDUCTION.

dangers of the manipulative methods are obviated, it is painless, the patients roll freely about in bed, do not have decubitus ulcers, and the only adjustment necessary is tightening the tongs a little each day. We have had no osteomyelitis of the skull, and have found this a satisfactory method of treatment in the nonoperative cases.

PLATE 34

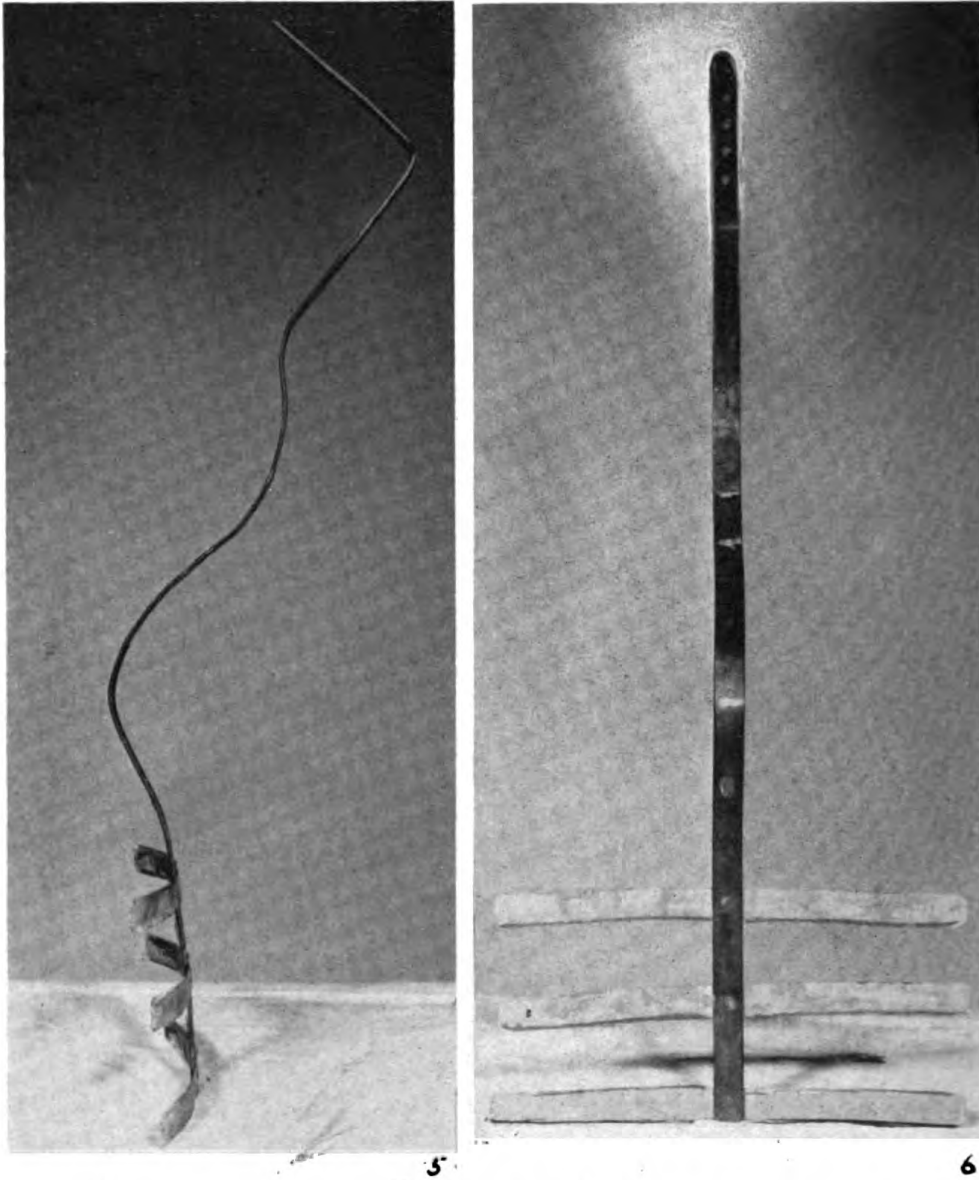


3. (CASE 2). ON ADMISSION, SHOWING FRACTURE DISLOCATION OF C4 ON C5 AND CHIP FRACTURE OF C7.—4. (CASE 2). SHOWING MAINTENANCE OF POSITION IN AMBULATORY TRACTION.

However, it occurred to us that if we could devise a method by which patients with fractures of the neck could be made ambulatory while keeping the tongs in place they might be made more comfortable, and the danger of forward slipping of the neck with recurrence of the deformity would be avoided. We also felt that if it were

necessary to evacuate such patients in the event of enemy action it could be more safely accomplished with the tongs in place. We, therefore, have constructed such an appliance and used it on two patients.

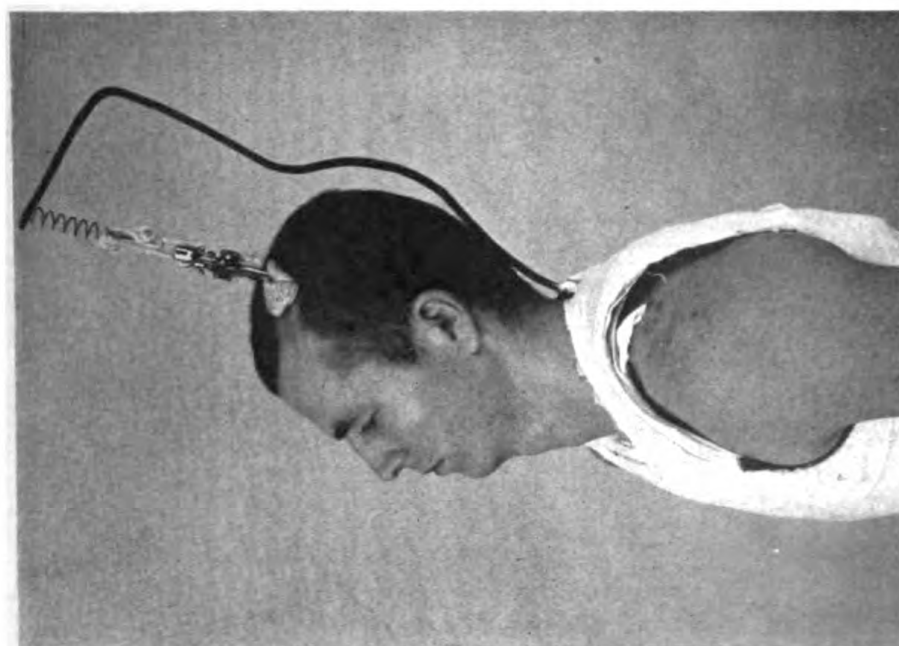
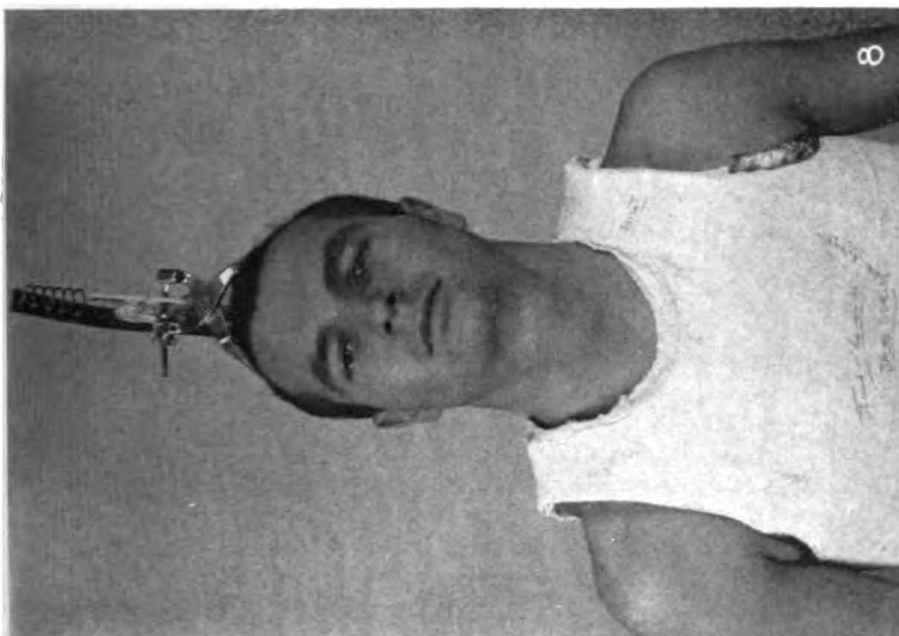
PLATE 35



5 AND 6. FRONT AND SIDE VIEWS OF AMBULATORY TRACTION DEVICE BEFORE INCORPORATION IN PLASTER JACKET.

The ambulatory traction apparatus consists of a steel strap 1 inch by $\frac{1}{8}$ inch bent to fit the contours of the body and incorporated in a plaster-of-paris jacket. This iron strap extends up over the head so that the tongs can be secured to it. We made ours from a walking iron, bent as shown in the accompanying illustrations (figs. 5 and 6)

PLATE 36



7 AND 8. PHOTOGRAPHS OF PATIENT IN CASE 2 WEARING THE AMBULATORY TRACTION DEVICE.

with several holes drilled in the top end for securing the tongs, and three cross pieces fixed to the bottom end to assure firm anchorage in the jacket. A short coiled spring was inserted between the strap and the tongs to take up the slack incident to variations in tension produced by changes in position. We feel that two things are essential for the maintenance of position: The jacket must be brought up on the neck posteriorly as high as possible and over the shoulders to secure firm fixation of the bar, and the iron must be strong and not too springy. If these precautions are not observed, hyperextension (and reduction) cannot be maintained. Constant vigilance to see that hyperextension is not lost is necessary.

CASE REPORTS

Case 1. C. G. S., age 25 years, admitted May 20, 1942, was thrown from an automobile 16 hours before admission. He sustained a compression fracture of the sixth cervical vertebra (fig. 1).

Crutchfield tongs were applied at once with 8 pounds traction. X-ray on May 24 showed good reduction.

On June 9, 20 days after injury, the device described above was incorporated in a plaster jacket, adjusted to 8 pounds traction, and he was allowed up for a few minutes. From this time on he was allowed up ad lib. He was quite comfortable in the traction, and wandered about the building. An x-ray taken in the apparatus June 13 (fig. 2) showed maintenance of reduction.

After 15 days in this type of immobilization, a Thomas collar was applied. The patient has been subsisting at home since and has had no recurrence of his deformity.

Case 2.—J. B. B., age 25 years, was admitted to the hospital May 24, 1942. The day prior to admission he dove into shallow water and sustained a fracture-dislocation of C4 on C5, a chip fracture of C7 (fig. 3), and a paralysis of the right deltoid.

He was placed in a halter with 10 pounds traction, as all of our tongs were in use. The next day tongs were inserted and traction reduced to 8 pounds. Postreduction x-rays on May 27 showed good alignment.

He remained in bed for a month. On June 26 the fixation appliance was incorporated in a plaster jacket. The deltoid power was about three-fourths normal by then. He was ambulatory from that date. X-ray taken June 26, showed maintenance of position (fig. 4).

Thomas collar was applied July 3, 1942.

The patient developed a hematuria on that date, and a hydronephrosis was discovered. He is quite comfortable at present in the collar, and deltoid power has returned in full.

CONCLUSIONS

A method of treating fractures of the cervical spine with Crutchfield tongs while permitting ambulation is presented, with two case reports.

We do not advocate this as a routine method of treatment. We feel that it has a place in instances where evacuation of the patient is necessary, where prolonged immobilization is necessary and reduction cannot be maintained in a plaster collar, and in elderly or plethoric individuals where prolonged recumbency is contraindicated.

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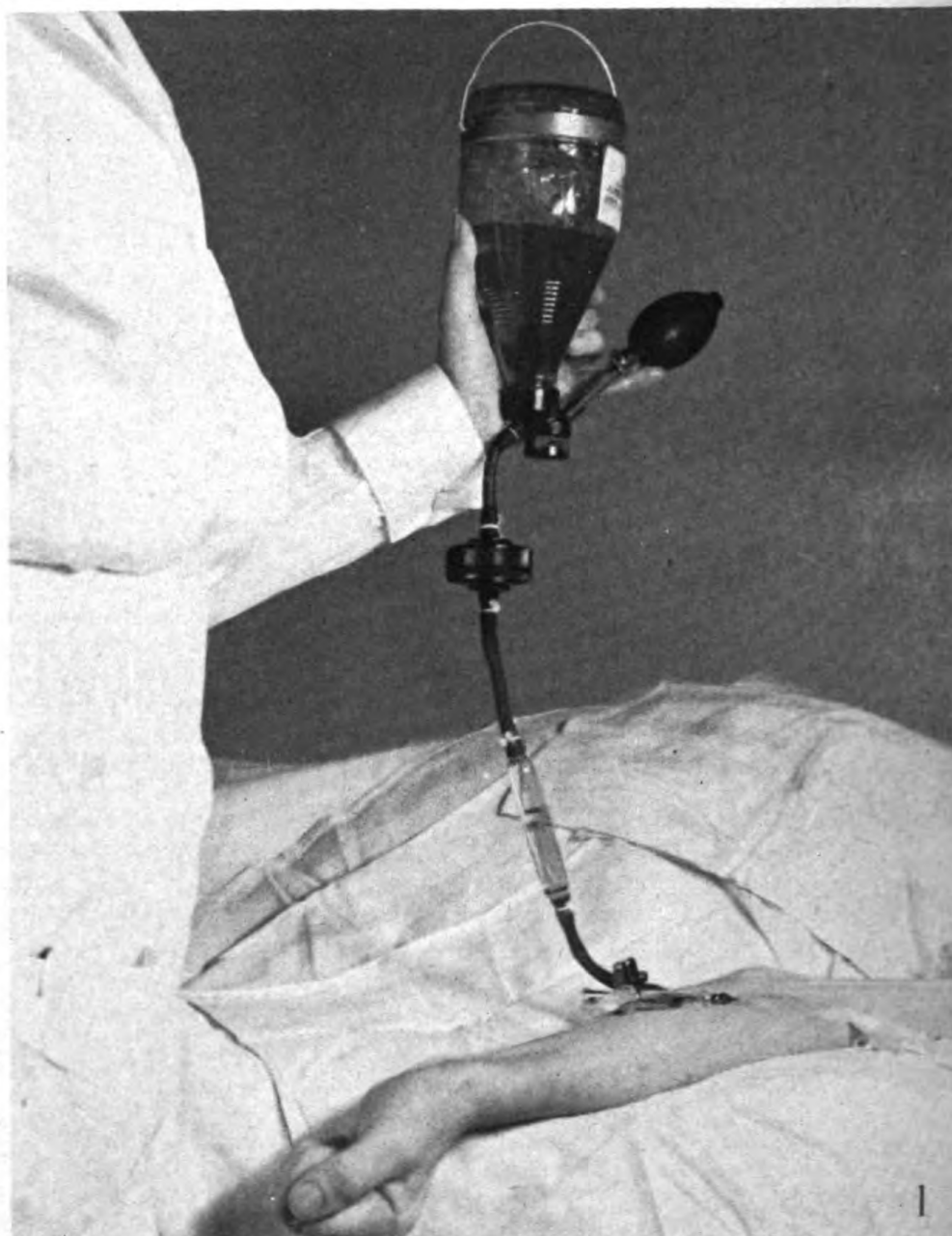
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AN IMPROVED METHOD FOR THE ADMINISTRATION OF HUMAN PLASMA AND WHOLE BLOOD¹

By M. D. WILLCUTTS, Captain, Medical Corps, United States Navy, and R. A. HICKS, Lieutenant Commander, Medical Corps, United States Naval Reserve

A great deal of attention has been paid to the mode of collection of human plasma but there has been relatively little emphasis upon the technic of administration of this substance to the patient. The ordinary gravity flow equipment is defective because it does not provide for the rapid administration of fluids in those instances when speed is desirable, is wasteful of pure gum rubber and requires extensive provision for specialized cleaning processes to avoid pyrogens. Substitute administration units made of cellophane do not meet all requirements of dependability, practicability, and economy.

¹ Received for publication July 6, 1942.



1. APPARATUS FOR THE ADMINISTRATION OF PLASMA BY AIR PRESSURE. THE COARSE STRAINER IS VISIBLE INSIDE OF THE PLASMA CONTAINER. THE FINE FILTER DISK IS INSIDE OF THE FLAT, BAKELITE CONTAINER SHOWN IN THE LINE. MINIMAL RUBBER TUBING IS EMPLOYED. AIR FILTRATION IS NOT ESSENTIAL. THE SIDE-ARM SYRINGE ILLUSTRATED IS EXCELLENT EQUIPMENT BUT IN FIELD WORK MAY BE REPLACED BY A GLASS ADAPTER AND PINCH CLAMP. ALL TUBING CONNECTIONS ARE SECURED. THE ILLUSTRATED TUBING IS SLIGHTLY LONGER THAN NECESSARY BUT AFTER SEVERAL USES THE STRETCHED TIPS SHOULD BE CUT OFF. THIS SET MAY BE ATTACHED TO A 2000 CC. BOTTLE AND A SERIES OF PLASMA UNITS ADMINISTERED TO EIGHT PATIENTS BY CHANGING ADAPTER AND NEEDLE ONLY. A BENT WIRE CLOTHES HANGER OR GAUZE STRIP MAY BE USED TO SUSPEND THE FLASK FROM THE NECK OF THE OPERATOR. RATE OF FLOW MAY BE CONTROLLED EITHER BY THE PINCH CLAMP OR THE DEGREE OF AIR PRESSURE. THE PYROGEN PROBLEM IN INFUSION EQUIPMENT IS OBTIATED AND THE CLEANING, PREPARATION AND STERILIZATION SIMPLIFIED. THIS EQUIPMENT FACILITATES A RAPID ADMINISTRATION OF PLASMA IN NAVAL PERSONNEL UNDER CIRCUMSTANCES WHEN SPEED MAY BE DESIRABLE.

It seems desirable to develop a mode of administration of plasma in which the equipment would embody a minimum of rubber, a maximum of dependability, a full responsive control of flow, both rapid and slow, a simplicity in cleaning and a minimum of space when ready for use.

The equipment illustrated has been found to fulfill the above requirements. The cleaning and sterilization of this set is essentially the same as that required for the preparation of an ordinary syringe. A single operator equipped with two of these sets may continuously

PLATE 33



2. APPARATUS FOR THE ADMINISTRATION OF WHOLE BLOOD. STRAINER INSIDE OF FLASK IS NOT VISIBLE. LINE FILTER NOT REQUIRED. THIS TYPE OF EQUIPMENT HAS BEEN SUPPLIED ROUTINELY THROUGHOUT A MOBILE STAFF OF ONE HUNDRED AND FORTY DOCTORS. SERIOUS DIFFICULTIES HAVE NOT BEEN ENCOUNTERED.

administer plasma by giving several units with one outfit (changing needle and adapter only between patients) and having that apparatus promptly disassembled, cleaned, boiled, and reassembled, while he works with the second set. The number of infusion sets required is governed more by the number of operators available than by the number of plasma units to be dispensed. This apparatus has a further advantage in that a small needle may be used and any desirable rate of flow still obtained by increasing the pressure developed above the liquid. When high pressure is used to speed flow through a small needle the rubber connections must be well secured.

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A universal adoption of this method would facilitate the intravenous administration of all fluids and would save great amounts of rubber.

A METHOD FOR EVALUATING THE MUSCLE BALANCE IN SO-CALLED "FLAT FOOT" IN RECRUITS FOR THE NAVY¹

By TRACY D. CUTTLE, Lieutenant, Medical Corps, United States Naval Reserve

One of the most difficult problems in the examination of recruits for the Navy is the examination of the feet. So-called "flat foot" is cause for rejection. The manual of Physical Examinations for the Medical Department of the United States Navy (1) states:

The feet will be especially examined for flat foot * * When any degree of flat foot is found the strength of the feet should be ascertained by requiring the applicant to hop on the toes of each foot for a sufficient time and by requiring him to alight on the toes after jumping up several times.

A doctor with years of experience in evaluating the strength of a foot from inspection and this test, may be able to select men who have depressed arches who will not develop symptoms, but the average examiner is not able to make this decision without a more objective test.

The Feiss line has been used to measure objectively in the degree of depression of the arches. However, many recruits with flat pedal extremities, and some of them have given excellent records of participation in athletics or long hours on their feet at work without any discomfort.

A report of a method devised by Osgood (2) to measure the muscle balance in foot strain seemed applicable to the problem of evaluating the feet of recruits for the navy. Osgood states that the major factors that maintain proper weight-bearing lines in the feet are the muscles of the lower leg which have their insertion in the feet, and, to a lesser extent, the muscles of the feet themselves. These are active, not passive supports. To measure the comparative strength of the adductor and abductor groups in the foot, he designed an apparatus and tested a large number of patients. By this means the patients could be grouped as follows:

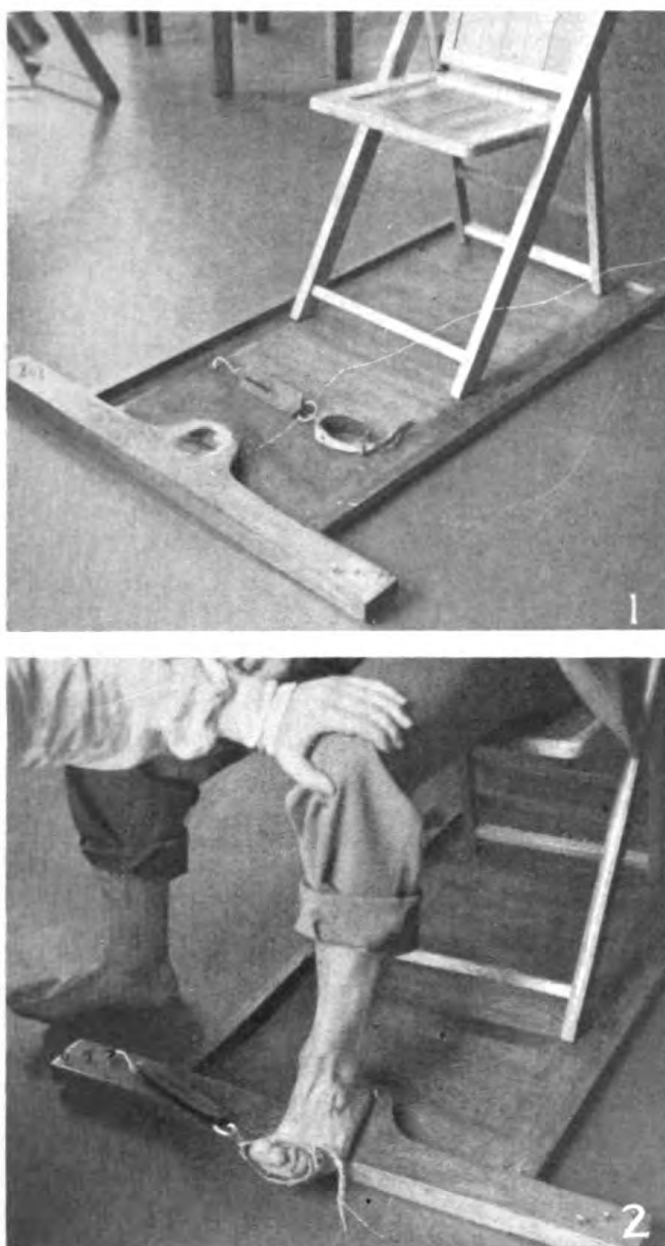
In the first group, which one may call the symptomless normal feet, the inverters of the foot, acting as protectors of the arches, were stronger than the everters or depressors of the arches in the ratio of approximately 5-pound pull of the inverting protectors to 4-pound pull for the everting depressors.

In the second group, also symptomless but exhibiting slight pronation, the pull of the two groups of muscles was approximately equal, but slightly in favor of the everters or depressors of the arches.

¹ Received for publication June 20, 1942.

In the third group, that of patients with more pronated feet seeking advice because of symptoms of foot strain, the pounds pull of the everters or depressors of the arches were definitely stronger than that of the inverters or protectors of the arches.

PLATE 39



1. APPARATUS FOR MEASUREMENT OF MUSCLE BALANCE IN THE FEET.—2. SHOWING TEST OF EVERTERS.

In the fourth group comprising the "acute flat feet" the ratio of pounds pull of the inverters to that of the everters was approximately 4:5, in other words, the reverse of the ratio that existed in the test of normal symptomless feet.

Dr. Osgood kindly loaned us a sample of his apparatus from which the modification illustrated in figure 1 was made.

METHOD

The recruit is seated in a chair and the heel of his foot is placed in the cup. A simple spring scale is attached to the foot by means of a padded leather stirrup and to a hook on the foot board. The recruit is instructed to pull with his foot against the spring scale (fig. 2). The operator places one hand on the recruit's knee to prevent the use of the muscles of the thigh. Readings are taken and the scale is then swung around in the opposite direction and the recruit is again instructed to pull against the spring. Readings are taken and recorded. The other foot is then tested in a similar manner.

RESULTS

This test has been applied to several hundred recruits and the results not only confirm the reports of Osgood but check closely with the findings of those medical officers who have had years of experience in the evaluation of the feet of recruits. Readings with a ratio of 5:4 for the inverters over the everters were regularly recorded for recruits with asymptomatic normal feet. Applicants with "congenital flat foot" without symptoms, so frequently seen in Negro recruits, also gave similar readings.

Applicants whose feet showed depressed arches with eversion and those who gave a history of painful feet almost invariably showed a stronger pull for the everters than the inverters in a ratio of 5:4 or greater.

SUMMARY

1. The evaluation of flat foot by inspection and the ordinary tests is difficult for medical officers who have not had years of experience in recruiting.

2. The measurement of feet by the Feiss line is unsatisfactory, as the symptoms from depressed arches are due to poor muscle balance rather than the degree of depression of the arch.

3. The apparatus developed by Osgood for the measurement of muscle balance in the feet is a simple, satisfactory, and efficient objective method for the evaluation of so-called "flat-foot" in recruits for the Navy.

4. The use of this apparatus has been a great help at this station and it is suggested that the method warrants further study and investigation as a procedure which might be adopted by the Navy in order to eliminate much future "foot trouble."

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DETERMINATION OF TNT (2, 4, 6-TRINITROTOLUENE) IN AIR¹

By THOMAS E. CONE, JR., Lieutenant, Medical Corps, United States Naval Reserve

With the great increase in personnel engaged in the manufacturing and handling of TNT it has become imperative to perform routine determinations of TNT in the air to which these men are exposed. No safe limits for TNT in air were established during the last war, largely because no satisfactory method for determining this substance in air was developed at that time. It is important to have a satisfactory method for determining TNT in order to correlate it with clinical findings among workers.

The Kay (1) colorimetric determination of TNT has been modified by the Department of Industrial Hygiene of the Harvard School of Public Health, Boston, Mass. This modification has been used extensively by the author with good results.

The test is based on the red coloration obtained by the addition of a weak solution of potassium hydroxide to the TNT in butanone. By making up permanent standards for visual comparison a quick and easy method for TNT determinations is obtained.

The test is performed according to the accompanying diagram. Butanone (methyl ethyl ketone) is used because it increases the stability of the color complex to several hours.

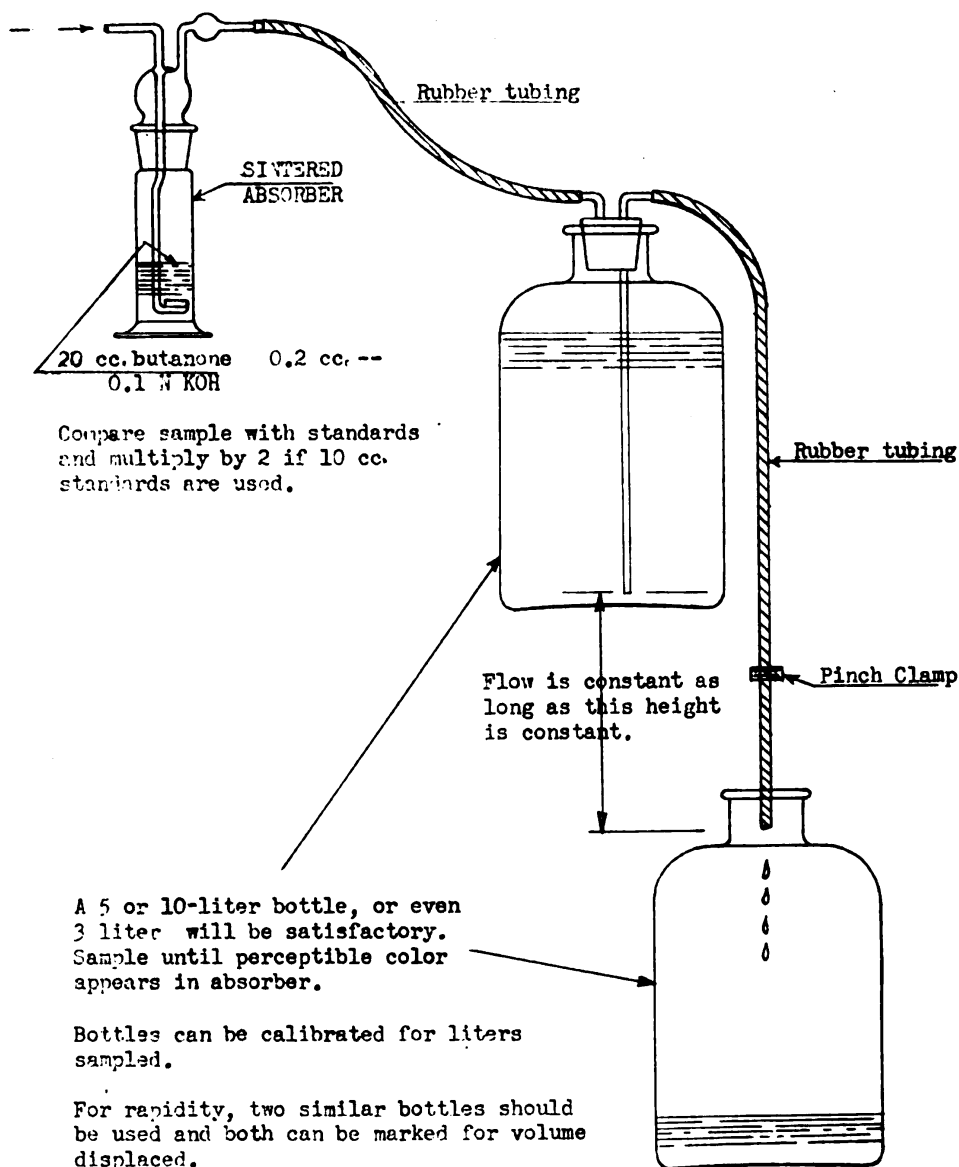
The stability of the color varies with the strength of the alkali used. The best results are obtained by using 0.1 cc. of 0.1 normal KOH per 10 cc. of butanone.

The proposed threshold level for TNT in air is 2.5 mg. per cubic meter. This method is able to determine readily 0.005 mg. of TNT. 2.5 mg. per cubic meter = 2.5 micrograms per liter of air sampled, so that a 2-liter sample of air close to the threshold concentration will show color. The bubbler and bottle sampling unit is adapted to both vapor and dust determinations (pouring and drilling).

¹ Received for publication July 8, 1942.

The sample concentrations may be made with standards prepared the same day by weighing out a known quantity of TNT, dissolving it in butanone (10 or 20 cc.), setting up serial dilutions, and adding the alkali (0.1 cc. of 0.1 N KOH per 10 cc. of butanone) to each tube. Comparisons can be made in 30 minutes to 1 hour. The tubes may be sealed and used for several weeks.

PLATE 40



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MULTIPLE STRETCHER¹

By H. C. WEBER, Commander, Medical Corps, United States Navy

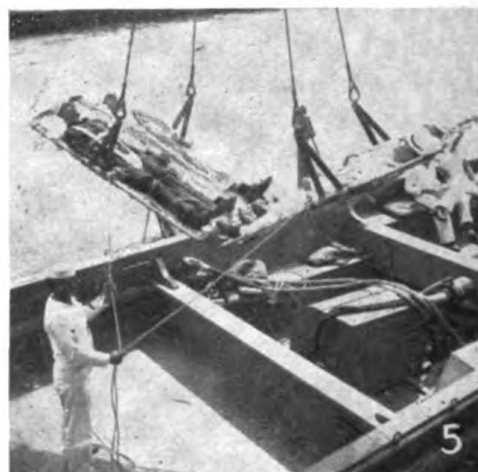
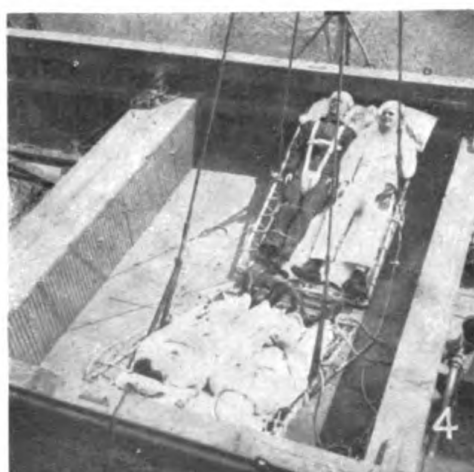
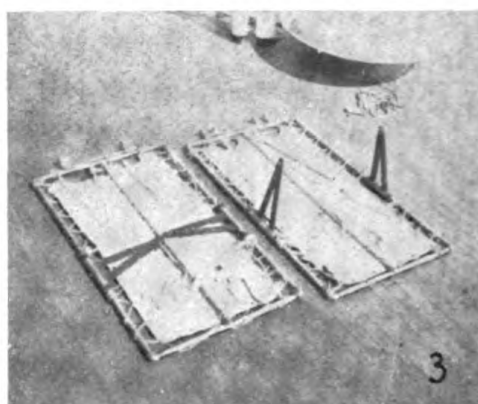
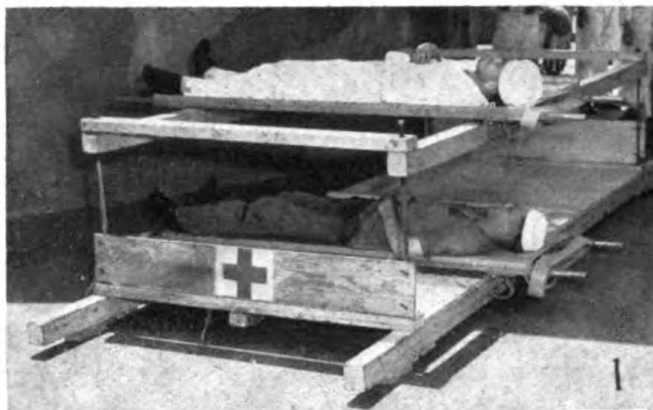
The problem of how to evacuate expeditiously numbers of wounded or sick men from the beach to a ship or from one ship to another, especially in rough weather, is always a pressing one. In this war, situations calling for quick evacuation of many wounded or sick may arise at any time.

Figure 1 shows a wooden litter hoist. While the litters rest firmly on this, and the hoist rests securely on the gunwales, it is not apparent how the patient is secured to the army litter to prevent him from sliding off if the motor launch should roll, or if in the act of being taken on board the hoist should swing to one side or the other. Besides, while unloading in rough weather it would be almost impossible to prevent the hoist being smashed against the side of the ship. In addition, this apparatus makes the motor launch top-heavy.

For these reasons the author designed the multiple stretcher, which consists essentially of two sections, each of two steel or duralumin pipe frames hinged together at the foot end. The individual patients are strapped to canvas sheets which in turn are securely laced underneath the frame by a 12-thread manila line. The weight of the patient is suspended from a harness running from the crotch to the shoulders and padded in the crotch by a cushion of two thicknesses of felt 5 inches by 10 inches in a muslin cover. There is an extra strap of 1½-inch width across the chest. All straps have 1½-inch belt buckles as carried by the United States Marine Corps aboard ship. The legs are held in place by four transverse tie-ties 20 inches long, 2 above the knees and 2 across the shins. The two T-type hinges mentioned are welded to the foot end of the frames. They permit the stretcher to open automatically as soon as the tension on the 10- or 8-foot carrying sling is released by the stretcher touching the deck. Four carrying arms secured to movable sleeves and placed at the proper distance from the top prevent the stretcher from closing to less than 125° when carrying a load. The four carrying arms slide upward one-half inch and lock automatically against a cut-out stop collar when the stretcher is hoisted. There are four other stop collars with eye bolts below, which allow the sleeves to move downward 1½ inches and to be folded medially for closing after use and for easy stowing. To the eyes are fastened the two ends of a 16- or 20-foot line which serves as a double guy line, being used like the reins of a harness. The two sections are kept apart at 125°, these calculations being based on center of gravity and parallelogram of forces. Even a strong pull on the guy line does not upset the equilibrium. Note

¹ Received for publication June 3, 1942.

PLATE 41



1. OLD ARMY LITTER HOIST.—2. FIRST DESIGN, DISCARDED. NOTE UNCOMFORTABLE POSITION OF PATIENTS AND DRAG ON CROTCH.—3. SECOND DESIGN, DISMANTLED. NOTE POSITION OF CARRYING ARMS. UNFORTUNATELY THE FOUR HARNESSES DO NOT SHOW BECAUSE OF LACK OF CONTRAST. HINGE ROD ON RIGHT CANVAS.—4. ENDS OF STRETCHER RESTING ON GUNWALES. SLING SLIGHTLY UNDER TENSION.—5. NEW DESIGN IN OPERATION. NOTE ABSENCE OF SPREADERS AND THE ANGLE. NOTE GUY LINE.

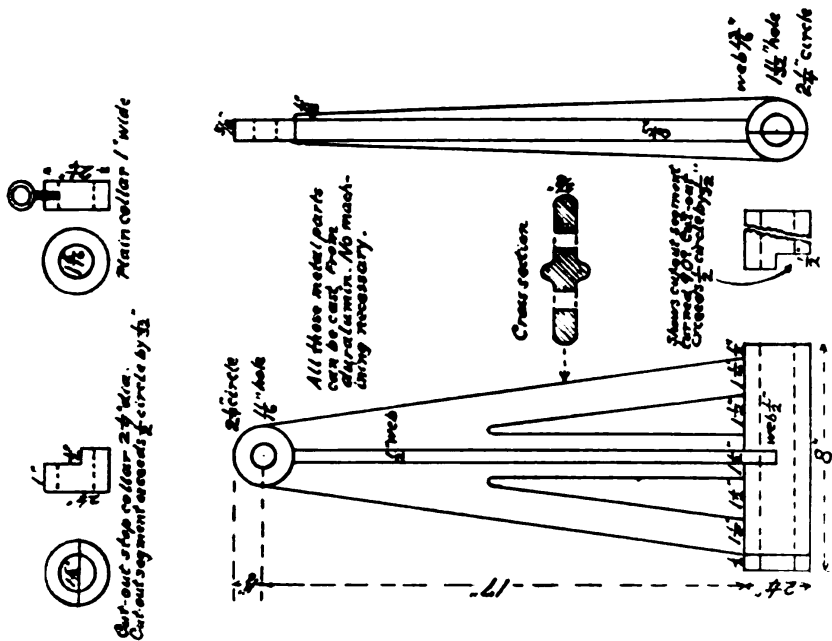
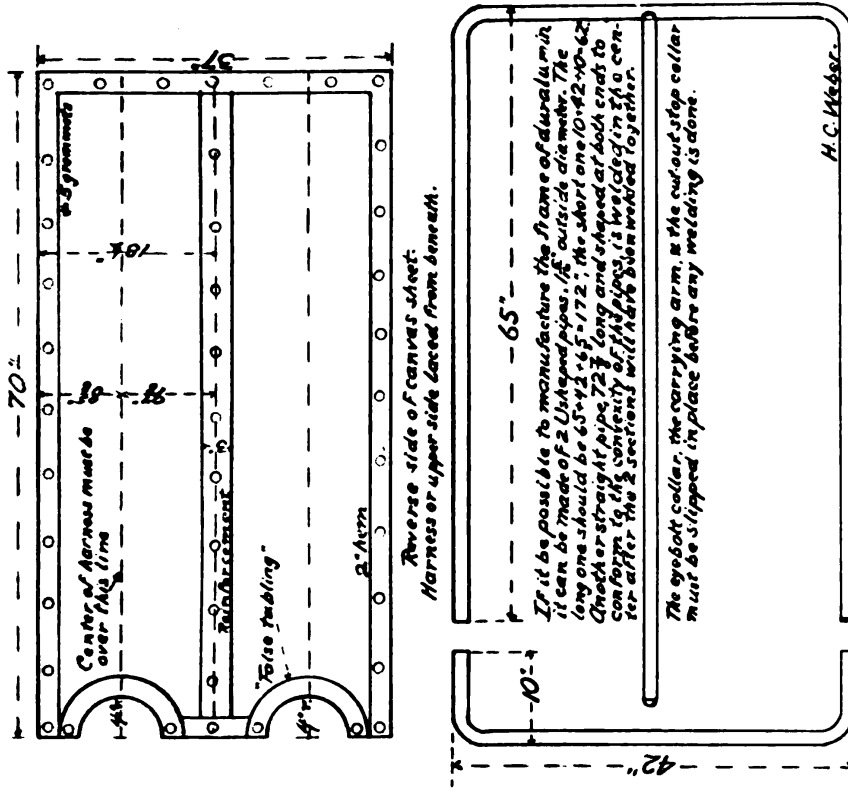
that the sling is of the same length as the double guy line. The carrying arms make a spreader unnecessary. To expedite attaching the sling to the stretcher substantial snap hooks should be secured to the four ends of the sling.

Proposed method of manufacture.—The frame of each section is best made of two pieces of duralumin pipe. After the lower collar with eye bolt, the sleeve with the carrying arm and the upper cut-out stop collar in that order will have been slipped in place over the vertical legs of the long pipe, the shorter pipe is welded end to end to the free ends of the long pipe completing the circumference of the frame. A straight piece of duralumin pipe is then welded to the center in the longitudinal direction to complete the frame. As the specific gravity of aluminum is one-third that of steel, the complete and finished multiple stretcher with canvas in place if made of duralumin should weigh only about 55 pounds. In addition to lightness, duralumin, of course, has the advantage of permitting the sleeve and carrying arm to be cast in one piece instead of being machined, as this alloy can be cast “sharply” or accurately enough. The upper cut-out stop collar and the lower stop collar can also be cast instead of being machined. They should be welded in place after they have been slipped over the pipes.

With a try-out of the sample steel stretcher by actual demonstration it was found that the weight could be materially reduced by shortening the sleeve to 8 inches, by having a carrying arm made of just one steel band three-eighths inch by 2 inches, braced by two strips, fore and aft, of 10 inches by 2 inches tapering off to one-fourth inch; by shortening the stop collar to $1\frac{1}{2}$ inches and the cut-out segment to one-half inch; and by reducing the outside diameter of sleeves and collars to $2\frac{1}{4}$ inches. It is believed that even one-quarter-inch steel band will be heavy enough for the carrying arm. Those medical officers interested in having the stretcher made on their own ships will be able to use 90° elbows for the corners. The distance of the hole in the carrying arm to the top of the stretcher is the important one; this should be $34\frac{1}{2}$ inches in the 75-inch stretcher and $33\frac{1}{4}$ inches for the 72-inch stretcher. This distance is best measured off when the carrying arm is turned down; in other words, it should be the vertical distance rather than the oblique.

Given a problem of carrying 20 or more severely wounded men from the beach to the ship, the following method would be employed. Sixteen patients could be placed on the bottom of the motor launch, and four could be strapped in position on the stretcher, while the boat was under way to the ship, ready to be hoisted on board on arrival. Stretcher bearers can then take them from the multiple stretcher and place them out of the way on the ship's deck temporarily, or carry them at once to the sickbay in the Stokes stretchers. The multiple stretcher in the meantime would hoist the next four on board and continue thus until the boat load had been taken on board. It will be noted that while the patients are secured in the multiple

Parts for Multiple Stretcher.



stretcher in the motor launch, the stretcher is in an athwartships position, and that it does not project beyond the sides of the motor launch. The accompanying drawing gives the necessary dimensions and specifications. The photographs show the multiple stretcher in operation and are self-explanatory.

The advantages of this stretcher are:

1. A greater number of stretcher cases can be carried on one trip of a motor launch. There is, of course, additional room in the motor launch for ambulatory cases.
2. The army litters can be left ashore to collect more wounded on the beach while the motor launch makes a trip to the ship with patients.
3. With every operation of the crane four men can be hoisted on board, instead of one.
4. Compactness.
5. Safety over the army litter hoist while in the motor launch and while hoisting on board is evident from the photographs.

Other possible uses:

1. Conversion of station wagons and delivery trucks into ambulances by providing proper brackets for the two sections and pulling out of the hinge rod. Inside dimensions of a Ford station wagon are 58 inches by 78 inches from back of driver's seat.
2. Emergency operating or dressing table if placed on saw bucks or other suitable supports ashore.
3. Stretchers for ambulance planes.
4. The frame without canvas, if made of proper dimensions, could be used to haul patients in four Stokes stretchers on board by placing the Stokes stretchers in the four compartments of the multiple stretcher.

The designer wishes to thank the shipfitters, machinist's and sailmaker's mates as well as the deck force for making the multiple stretcher, and Carpenter C. W. Lang, U. S. N. for making the proper hinge, as well as Boatswain D. B. Russell, U. S. N. R., and others for their assistance.

A TECHNIC AND DEVICE FOR APPLICATION OF ICE ANESTHESIA FOR AMPUTATION OF EXTREMITIES¹

By J. A. KENNEDY, Chief Pharmacist's Mate, United States Navy

The original methods of ice anesthesia advocated the use of rubber sheets to hold the ice. The writer and Dr. Jules D. Gordon of New York City, found that method faulty in many ways, i. e., the contour of the sheets was changing constantly, due to melting ice, and this caused imperfect total application of the ice; water seeped around the perineum and buttocks of the patient with attendant discomfort and a generally sloppy condition, especially on the way to the operating room. To offset these obstacles the writer conceived the device mentioned herein and applied it with efficacy in a number of cases.

¹ Received for publication August 5, 1942.

The technic originally advocated is essentially the same as the one presented with the addition of the application of an Esmarch rubber bandage to drain the blood from the limb toward the body. This is in itself an autotransfusion, giving a supportive effect and helping make the amputation for the most part only a loss of substance.

The technic used by the writer is as follows:

1. Apply three ice caps to tourniquet area for 15 minutes and hold in place with a piece of muslin.

2. Keep limb elevated during this period.

3. A minute before this time is up apply an Esmarch rubber bandage firmly and slowly from above the area of inflammation to the tourniquet site.

4. At the expiration of 15 minutes remove the ice caps and use the piece of muslin to protect the skin and then apply the tourniquet. Remove the rubber bandage. Then the limb is ready for the application of ice.

5. The bottom of the ice container has previously been prepared with a layer of finely chopped ice on an incline distal to proximal. (The writer uses a rubber ring above the tourniquet to fill the space between the leg and the side and end of the container. The device calls for a rubber U for this purpose but due to the rubber shortage an improvised filler may be made of a small rubber composition sheet or other impervious material.)

6. The limb is placed in the ice container and covered with finely chopped ice to 2 inches above the tourniquet. The head of the bed is "gatched" up and the bed placed on small blocks at the head to facilitate drainage. (The bevel in the ice container at the proximal end provides for use of a urinal or bed pan.)

7. The limb is kept in the ice container for 2 hours, being examined at intervals and ice being added if needed.

8. After 2 hours the patient is taken to the operating room. The limb is removed from the ice, dried off, and is ready for amputation. The operating crew should be ready to go into action as soon as the patient is placed on the table.

Preoperative sedation is prescribed by the surgeon (barbiturates, scopolamine, morphine, etc.)

After the operation three ice caps are applied to the stump for the first 24 hours, then two ice caps for the second 24 hours and one ice cap for the third postoperative day.

The device or container mentioned herein is illustrated in the accompanying drawings. There is sufficient depth and width to provide for arthritic fixation. Drainage is provided at the distal end, which may be shut off when en route to the operating room. A rubber inflatable U fills the space between the leg and ice container.

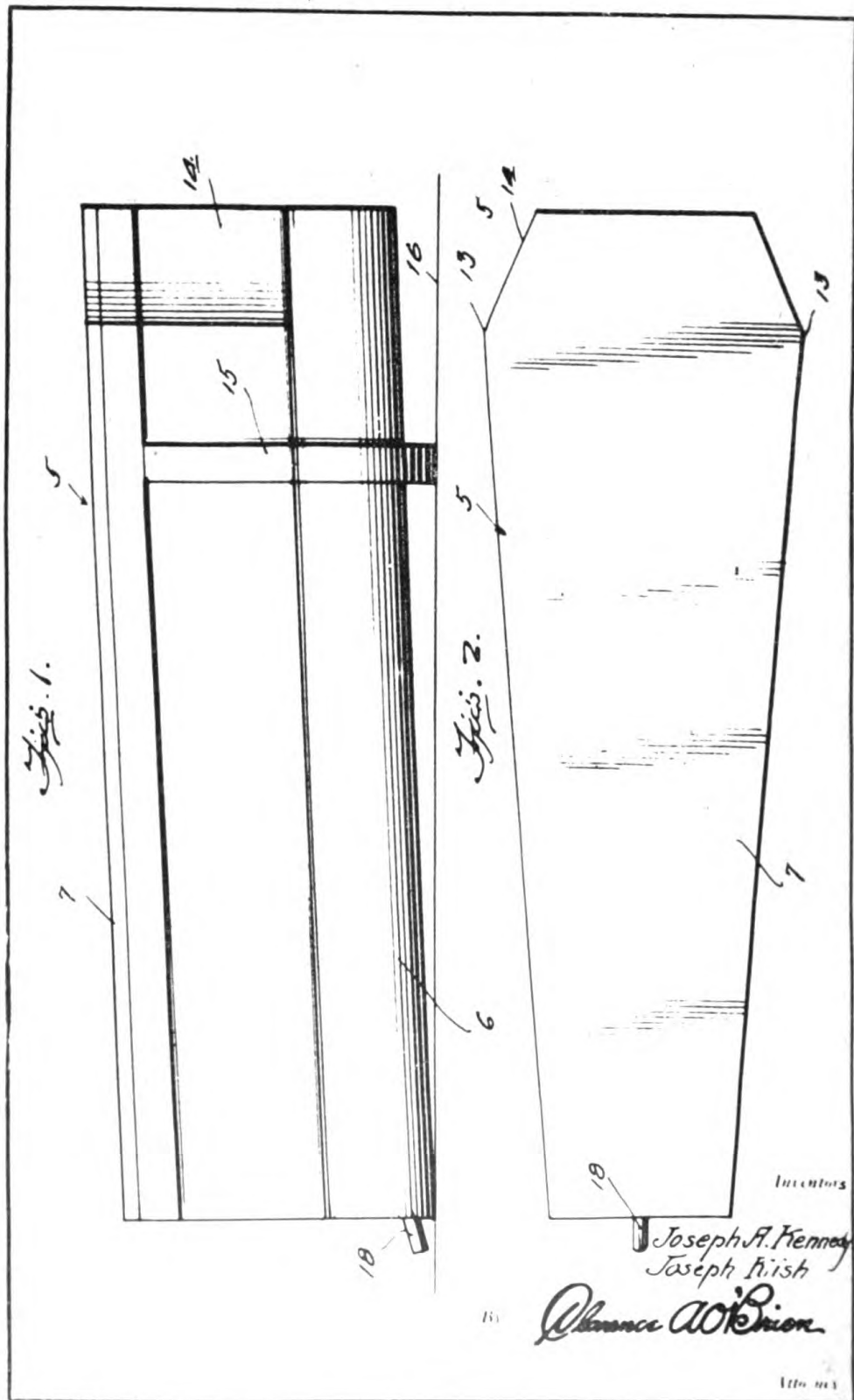
DISCUSSION

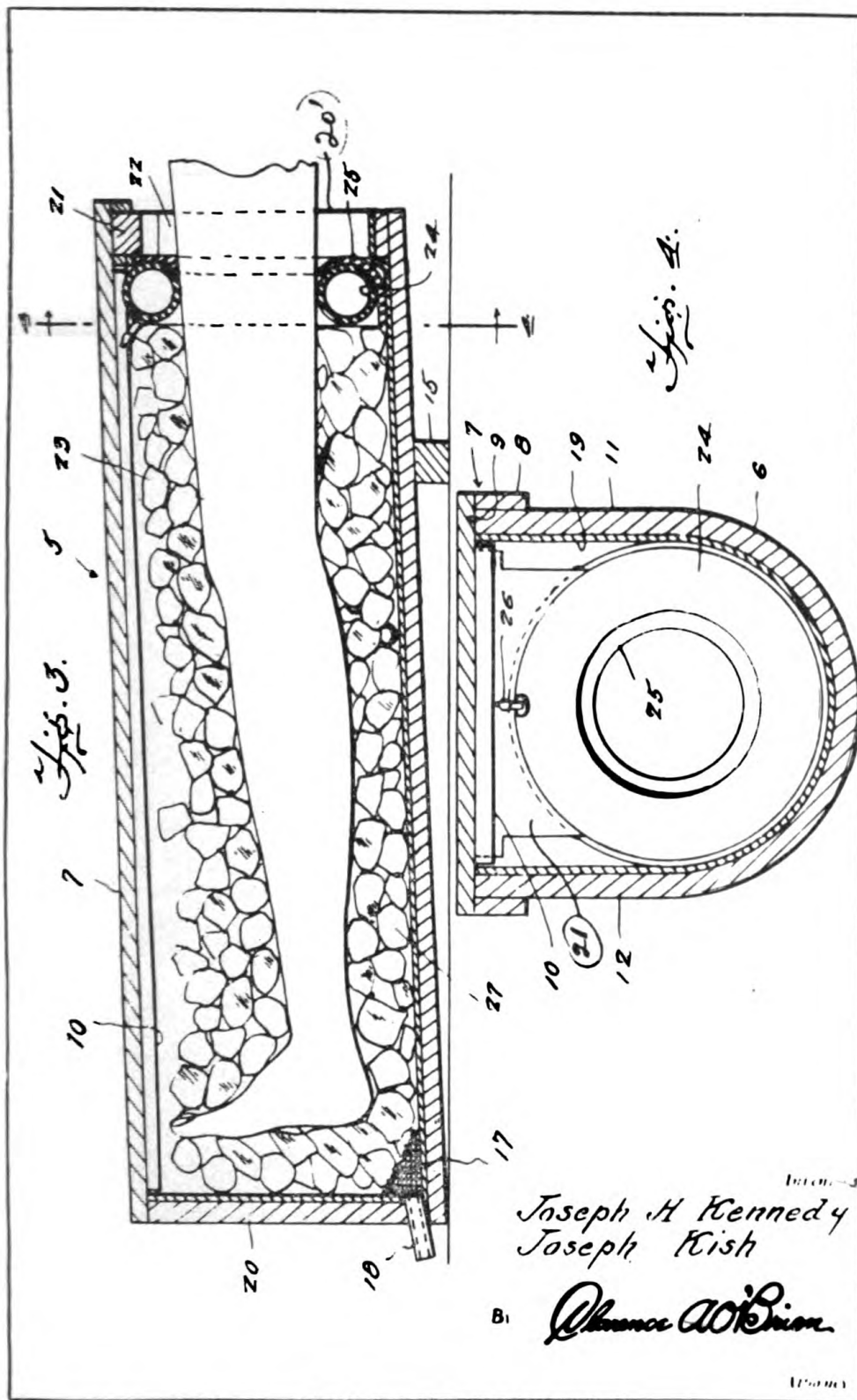
The writer has presented a technic and a device for the effective application of ice to induce anesthesia in the extremities for amputation.

He has assisted in a dozen or more cases using this method of anesthesia and has successfully used this device in a number of them with efficacy and dispatch.

In addition to gas and diabetic gangrenes, it is believed that this method and device could be of service in war wounds necessitating amputation, ashore or afloat. Ice is at hand in all of the large ships

PLATE 44





equipped with operating rooms and operating equipment. Ashore an automobile could be equipped with ice-making machinery and could accompany expeditions.

The number of cases mentioned herein were mainly of diabetic gangrene of the feet complicated by advanced age (60 to 80 years), cardiac, renal, vascular, and hypertensive pathology. In one instance a debridement was attempted under gas-oxygen anesthesia with almost fatal results due to respiratory failure. Later this case was successfully amputated under ice anesthesia, as above.

Gratitude is expressed to Dr. F. W. Bancroft, Chief of Surgery, Dr. Jules D. Gordon, aforementioned, and other members of the Surgical Staff of the Beth David Hospital, 161 East 90th Street, New York, N. Y., for the courtesy and encouragement extended to the writer in the use of this device and method of anesthesia. Likewise profound thanks are extended to Sydenham Hospital, New York, which called upon Dr. J. D. Gordon and myself for a demonstration on one of their cases.

NOTES AND COMMENTS

REHABILITATION AFTER INJURIES TO THE CENTRAL NERVOUS SYSTEM

The following discussion on the above subject is of broad enough interest to be reprinted in almost its entirety from Proceedings of the Royal Society of Medicine, February 1942:

Professor HUGH CAIRNS: In any discussion on rehabilitation of head injury patients it is important to consider the main factors which influence the patients' disability.

1. *The time factor.*—The time factor varies greatly from case to case. After a head injury the patient goes through a cycle, beginning with unconsciousness, thence through a stage of confusion and a period in which he is liable to headaches, to a final stage in which he is restored to normal or near-normal. This is a spontaneous process. The time taken for its completion may be in one case only a few weeks, in another as long as 18 months, depending to a large extent upon the severity of the initial injury.

This time factor must always be taken into account in planning the rehabilitation of head injury patients, the more so because we do not yet possess adequate tests by which to measure the recovery of the higher levels of intellectual function. A man may appear on testing to have recovered his faculties completely, and yet he will fail on the intellectual level when he returns to his work. In deciding when a patient should be fit to return to work it is therefore necessary to bear in mind the severity of the post-traumatic amnesia (P. T. A.). As a working rule I would suggest that the shortest time in which ability to carry out full work may be expected to return is as follows:

P. T. A. 5 minutes to 1 hour.....	4 to 6 weeks
P. T. A. 1 to 24 hours.....	6 to 8 weeks
P. T. A. 1 to 7 days.....	2 to 4 months
P. T. A. over 7 days.....	4 to 8 months

I put this forward tentatively as a rough measure to be used in planning rehabilitation. It can be no more than a rough working guide because the duration of post-traumatic amnesia is influenced by other events besides the severity of the brain injury, e. g., the amount of bodily fatigue present at the time of injury, large doses of morphia or a general anesthetic shortly after the injury, epileptic

seizures in the first days after injury, and various psychoneurotic factors. Furthermore, we know that in certain cases where there is a fracture of the base of the skull and the amnesia is short-lived, damage to the cranial nerves may interfere with return to work long after the higher cerebral functions have recovered. The type of work must also be taken into account; a simple task may be resumed earlier than one which involves the higher levels of intellectual function.

2. *Disturbance of mental capacity.*—The central disturbance, the main organic cause of disability after head injury, is disturbance of mental capacity. It may occur at various levels of mental activity. At the lower levels there may be disturbance of speech, reading, calculating, or orientation. Initiative, memory and concentration may be affected. At higher levels there may be impairment of judgment, or of the capacity for abstract reasoning. The patient cannot be satisfactorily guided through the stages of rehabilitation without an attempt on the part of the doctor—however halting it may still be—to assess his mind in terms of these functions. After severe head injury the question will arise whether the patient is likely to be fit for his previous work, and this will often largely depend upon his retention of the capacity to learn. While the patient continues to show improvement an adverse decision should usually be withheld.

3. *Emotional disturbance.*—Emotional factors are inextricably bound up with the process of recovery. The unstable type of man will have additional difficulties in adjusting himself to the task of returning to work, and it is therefore incumbent on those responsible for rehabilitation to assess the man as well as the severity of his injury. This is best done not only by observing the patient's behaviour while under observation, but also by a systematic inquiry into his family history, and into his earlier life and illnesses. The doctor may learn, especially in the cases of soldiers in wartime, that before his accident the man was not employed, or felt that he was not employed, in the type of work for which he was best fitted.

Emotional disturbance may interfere with all aspects of intellectual activity and may be itself precipitated by these defects. The patient who becomes confused at a task tends to have a feeling of inadequacy which may lead not only to headache and outbursts of irritability but also to complete suppression for the time being of his powers of thinking: The phenomenon described by Goldstein as the catastrophic reaction.

4. *Post-traumatic headaches.*—Anyone who is responsible for the rehabilitation of patients with head injury must formulate his ideas about the post-traumatic syndrome—the attacks of headache, dizziness, irritability and confusion which occur so commonly after the

initial recovery from head injury. There are large gaps in our knowledge of this syndrome, and no little disagreement as to its nature. It is necessary, nevertheless, to have some working hypothesis, otherwise what shall one say to the man who complains of headaches during convalescence? I believe that almost every patient who makes a full recovery from concussion suffers at a certain stage of his recovery from headaches. In the mild head injuries the headaches may occur sporadically for some weeks and then disappear. In the severe cases the headache may not come on until long after the patient has left hospital, and may not come on at all if there is any serious degree of residual organic defect. The patient must have recovered a certain amount of mental clarity before he appreciates headaches.

Now it is one thing to have a headache; it is another thing to complain about it. Although attacks of headache occur fairly constantly the reaction of the patient to them varies considerably, depending on a variety of factors, such as the emotional make-up of the patient, his anxieties and fears, his ability and desire to cope with his work once more. Emotionally stable, well-adjusted, and reliable witnesses—for example, most doctors—will describe their difficulties in concentrating when first they return to work; they will ascribe their headaches to attempts to concentrate, their headaches or dizziness to exertion or change of posture. Identical symptoms are complained of by other patients who are unstable and badly adjusted, but nevertheless reliable witnesses. The difference is that the first type will manage to carry on with their rehabilitation with the minimum of interruption, while the second type are likely to break down on return to work unless they are given special treatment, treatment that inevitably comes within the purview of rehabilitation.

If this view as to the incidence of post-traumatic symptoms is correct then we must regard the syndrome as organic, just as syncope is; but, like syncope, it is influenced by emotional and psychoneurotic factors.

The early stages of recovery.—Rehabilitation begins when the patient begins to talk and respond properly. How does he discover that he has had a head injury? As his confusion clears he slowly puzzles it out for himself, with the explanations which come better from the doctor, with reassurance, than from the relations. The explanations and reassurance may need to be repeated more than once, for although the patient may be able to conduct a conversation in a manner that gives a superficial appearance of normality, yet he is at this stage confused, disorientated, and forgetful, for a period varying between minutes and weeks, according as the brain injury is mild or severe.

This is the stage at which assessment of the brain damage and of the type of the patient can first be undertaken. Without such investigations the rehabilitation cannot be adequately planned.

Getting up.—Notwithstanding the recommendations of Symonds, these patients are often kept in bed too long, on the assumption that the liability to post-traumatic headaches is thus diminished. There is no evidence in favour of this view, and the practice becomes a bad one when, as so often happens, the next stage of rehabilitation is hurried.

There is rarely reason why the patient should not be allowed to get up a few days after he has recovered consciousness. Thus, a man whose total amnesia is 6 hours or less can be got up gradually towards the end of a week. If he gets a headache, he can be put to bed with some aspirin, and can get up again next day. Recourse to bed is, however, rarely necessary, for headache is not a conspicuous feature of this stage of recovery. The fact that the patient is got up early does not mean that he is to go back to work early. In cases of prolonged confusion and irritability, after unconsciousness of a week or more, the effect of sitting the patient out of bed and of giving him baths is often most soothing.

Graduated physical activities.—From the stage of getting up graduated physical (and mental) exercise may begin. It is necessary to grade the exercises and the speed with which the patient passes from one stage to the next depends, not only on his progress with the exercises, but also on the estimated severity of his injury. For the mildly concussed the physical exercise can take first the form of walking and light physical training, thence by stages to more strenuous physical training, games, and heavy physical work. For the severely injured who, when they first get up, are still confused and even disorientated, light exercises to music, gentle indoor ball games, and deep breathing exercises are useful. These patients need much individual attention, and plenty of rest between exercises. Patience is necessary, also, for they often forget a game and need to have it explained to them all over again. No exercise should be pushed to the point of provoking a catastrophic reaction.

What is the value of physical exercise? It hardens the patient physically, thus preparing him to adjust himself the more easily to the physical demands of his normal life. It provides also a sense of achievement which is valuable in a man who is mildly confused and incapable of concentrated mental effort. It helps him to escape boredom. And it is perhaps also beneficial in modifying intracranial pressure.

At what stage should the patient be called upon to do violent physical training, Swedish exercises, and the like? Opinions differ on this question. There are some who would start it within a few weeks of quite severe injuries; others would introduce it more gradually and at a later stage. Before doing severe exercises the patient

should, in my opinion, pass successfully through a stage of light competitive games.

Occupational treatment.—While physical reeducation is going on, handicraft can provide simple tasks within the powers of most patients, tasks which occupy their time at a stage when they are incapable of reading or talking consecutively for any length of time and which give them a sense of achievement: Leatherwork, basketwork, pokerwork, weaving at a handloom, and bookbinding. Heavier crafts such as carpentry, metalwork, weaving on large looms, and outdoor occupations, such as gardening and house decorating, come later.

In craft work the teacher must constantly bear in mind that what really matters is not the initial standard of performance, but the degree of improvement shown from day to day. So often the star pupil of the class proves to be a psychoneurotic with headache after a trivial head injury.

Mental exercise.—The simplest mental exercises are those connected with movement, where the alternations of movement require concentration. For the confused patient simple games of a childish kind without competition are useful, for example, sorting cards according to colors, shapes, or what is written on them. It is an index of their degree of confusion that grown men will play these games with considerable pleasure.

In the later stages mental exercises should be directed towards the specific defect. Testing of the mental processes comes first and is in itself treatment. Special exercises can be introduced for lower level defects, such as those of reading and calculating. Sometimes it is possible to supplement the damaged functions, as, for example, by encouraging the patient with a defect of reading to trace or copy the words he is trying to read, or by teaching lip reading to a patient whose difficulty is in understanding the spoken word. The prognosis depends on the residual learning capacity.

It is doubtful whether special, graded mental exercises can seriously compete with the patient's own attempts to reeducate himself, once he has, by testing, been shown the way; but the value of encouragement by means of continued supervision cannot be overestimated.

Visual treatment.—No patient can relearn intellectual tasks unless his sight is good, and as many of these patients have visual symptoms, diplopia, phorias, or errors of refraction, it is important that ophthalmological treatment should be given whenever necessary.

Psychological factors.—The importance of psychological factors has already been indicated, and no attempts at rehabilitation are likely to be successful unless the patient's anxieties and fear are as-

suaged and unless he is helped through the phases of depression and the other disturbances of feeling that so often beset him during recovery from head injury.

The final test.—It is very difficult in hospital or convalescent institution to provide a test of full recovery, and the final test is the patient's return to work. It is the duty of those in charge of rehabilitation to see that the man is adequately supervised during this period, and that any special points concerning graduation of his work in the initial stages should be made known to his family doctor, his works doctor, or his Unit medical officer.

PREVENTING LIMITATION OF MOTION IN JOINTS FOLLOWING WOUNDS

The following is an interesting abstract of the views expressed by a medical officer of the Russian Army in regard to the use of passive and active motion following wounds of joints or wounds involving large scars.

"Limitation of mobility in joints as the result of wounds in the majority of cases can be prevented by physical exercise or so-called medical gymnastics.

"A recorded case described an incident where a shell splinter smashed the palm of a soldier's hand, injuring the bones of his fourth and fifth fingers. A plaster cast was applied to the hand and for a long time it remained immobile. When, a month later, the plaster cast was removed, mobility was lost not only in the injured fingers but also in the uninjured fingers because of the long period of inactivity of the hand.

"Hand wounds are mistakenly referred to as light wounds. They may be called light only from the point of view of saving human life. But, without a normally functioning hand or fingers a man can't work, let alone be a full-fledged fighter. This is especially true since these light wounds of hands and fingers often produce complications limiting mobility in joints and lowering the efficiency of the soldier.

"Hospital statistics show that in this present war, wounds of hands and fingers occupy one of the first places on lists of casualties. Hand and finger wounds are mentioned as an example of the tremendous importance of medical gymnastics in the endeavor for quick recovery and return of the soldier to duty.

"Timely application of medical gymnastics is an important factor determining complete recovery of joint mobility of hand and fingers. Of all men discharged from the Leningrad Naval Hospital with such

wounds, 97 percent returned to duty completely recovered, 2.3 percent to inactive service and the remaining 0.7 percent to the reserves.

"Medical gymnastics may be and should be applied to other injuries as well. In the present war the majority of wounds are sustained not from bullets but from splinters of mines, shells, bombs and grenades. Such wounds are distinguished by their torn and smashed state, the healing of which is usually accompanied by large scars which tighten the adjacent joints and limit their mobility. These are the so-called scar contractures which very often lead to lifelong invalidism. Medical gymnastics can save the wounded from these contractures.

"These medical gymnastics consist of a workout in the morning, individual programs after breakfast, walks and skiing after dinner. The wounded perform various chores, i. e., clean snow, cut wood, et cetera."

STAFF CONFERENCES AT SMALL ISOLATED STATIONS

William H. Funk, Captain, Medical Corps, United State Navy, is responsible for the following interesting suggestion for staff conferences at small, isolated stations:

"The writer for many years has been identified with staff conferences at naval hospitals, as spectator, participant and director. It is believed that such conferences, participated in by all members of the staff, are extremely valuable in keeping up professional interest. In contrast, small isolated naval stations with a scarcity of clinical material suitable for conferences, miss out on such valuable professional training.

"The following plan for weekly conferences has been in operation successfully for the past year at such a unit. The conference is attended by all medical and dental officers, the pharmacist and the chief nurse. Events of the past week, changes in existing orders, new plans of operation are freely discussed and commented upon. Suggestions for improvement are invited from all. The dental officers, pharmacist, and chief nurse are then excused and the medical officers remain for the purely professional part.

"Each weekly issue of The New England Journal of Medicine containing the Cabot Case Records, as it is received, is turned over to the senior dental officer, who is responsible for bringing to each meeting the new issue which no other officer has seen. In turn, each week, a different medical officer reads the presentation of the case from the Cabot Case Records. Then each medical officer discusses the case and gives his diagnosis. After provisional diagnoses have been made, the differential diagnosis discussion is read from the Journal. This

is followed in turn by discussion from each medical officer. Finally the anatomical diagnosis with the pathological discussion is read from the case record. This in turn is followed by such discussion as may be fitting.

"These discussions of case records have been much enjoyed and have seemed to stimulate the professional interest of all concerned."

EFFECT OF ADRENALIN ON THE BRONCHIOLES IN ASTHMA

The action of adrenalin in asthma is so striking in its almost immediate relief of the acute attack that the following note from the official journal of the British Medical Association will be of interest. It explains a number of seeming paradoxes in asthma and the pharmacologic effects of adrenalin on the bronchioles.

"Daly and his colleagues in Edinburgh have recently described an interesting investigation in which they show that in certain conditions adrenalin has an effect on the bronchioles opposite to that usually produced, so that bronchoconstriction follows. Some asthmatic patients are known to develop an attack when exposed to a sudden emotional stimulus or when beginning exercise—that is to say, at times when adrenalin may be presumed to be liberated and, according to accepted ideas of its action, to dilate the bronchioles. The experimental observation that in some circumstances adrenalin does not dilate but actually constricts the bronchioles promises to harmonize the clinical observation with physiological knowledge very satisfactorily. The experimental methods used require a high standard of skill. In this investigation the results have been obtained not merely by perfusing the lungs but by means of a preparation in which the right and left lungs of a dog were separately perfused, with the use of defibrinated or heparinized blood. In earlier observations Daly, Mark, and Petrovskaja had found that injection of adrenalin into the blood going to the pulmonary artery produced bronchoconstriction when posterior pituitary extract was injected first. The present work shows that this preliminary administration is unnecessary, and that adrenalin produces bronchoconstriction if the lungs are perfused for two hours with blood from which adrenalin is absent. That is to say, the prerequisite for observing this paradoxical effect is that the lungs should have suffered from hypo-adrenalinaemia for a longish time. There is at present no attempt to explain the phenomenon. The bronchoconstrictor action of adrenalin does not necessarily persist, and just as the asthmatic precipitated into asthma by an emotional stimulus can be rescued by a later injection of adrenalin, so the bronchoconstrictor response of the isolated perfused lung to adrenalin may be followed later by the more usual bronchodilator response."

YEAST TREATMENT OF LATRINES

The Headquarters, Panama Canal Department uses the following treatment of pit latrines at semipermanent and permanent camps:

Preparation of yeast for pit latrine treatment:

1. Sugar water is prepared by adding one-half teaspoonful granulated sugar, or one teaspoonful molasses or cane syrup to each quart of water used.

2. One-half ounce of compressed yeast made into a paste by the addition of water is added to each gallon of sugar water.

3. The inoculated mixture is kept at atmospheric temperature for 18 hours. At the end of 18 hours the yeast culture is ready for use in the treatment of latrines.

4. When 5 gallons or more of yeast culture is to be prepared, 2 ounces of yeast will be used to inoculate each 5 gallons of sugar solutions. For fractions of 5 gallons, one-half ounce per gallon of sugar solution will be used.

Treatment of latrines.—One quart of the prepared yeast culture should be added to each latrine hole twice each week; for example on Tuesday and Friday of each week. Fresh cultures should be prepared the day prior to the day set for treatment of the latrines.

Experience has demonstrated that when the yeast treatment of pit latrines has been properly carried out, pit latrines 10 to 12 feet deep have been used continuously for 6 to 10 months with perfect digestion of the deposited material.

All yeast-treated latrine boxes must be flytight and must be provided with a fly trap at each end. The fly trap must be so placed that light which attracts flies to the trap is admitted to the latrine box.

SUSPENSION OF FELLOWSHIP DUES

The Board of Regents of the American College of Surgeons has authorized exemption from further dues during the period of their full time active military service for Fellows of the College now in the Armed Services. They point out, however, that the suspension of the payment of dues is not to be interpreted as a credit toward the total amount which is required for the paid-up fellowship—namely \$500, comprising the fellowship fee and annual dues.

THE WELLCOME PRIZE FOR 1942

The Association of Military Surgeons at its annual meeting held at San Antonio, Tex., November 5 to 7, awarded the Sir Henry

Wellcome Medal and Prize to Lt. Comdr. Arthur P. Black, (MC) USNR.

The assigned subject was "Measures of Preventive Medicine Recommended by the Federal Medical Services to Insure the Maximum Improvement of the Selectee of 1961 over him of 1941."

The author was born in Nebraska, June 16, 1900. After attending Oskaloosa, Iowa, High School where he graduated in 1917, he went to Amherst College, graduating with an A. B. degree in 1921. He graduated from Johns Hopkins University with an M. D. degree in 1926.

He did research in organic chemistry, 1921-'22, was an intern at Johns Hopkins Hospital 1926-29. September 1936 to June 1937, he was associate professor of medicine in charge of the division of pediatrics, Peiping Union Medical College, 1931-'36, under the auspices of the Rockefeller Foundation. He returned in September 1936 and was pediatric consultant to the Maryland State Board of Health until January 1937. At that time he went into private practice in El Paso, Tex. He is a licentiate of the American Board of Pediatrics and a fellow of the American Association for the Advancement of Science. While in China he was associate professor of medicine in addition to his pediatric duties. He is a Fellow of the American College of Physicians and was commissioned Lieutenant Commander in October 1939.

This is the third successive year in which the award has been won by a medical officer of the Navy; i. e., in 1940 by Capt. Lucius W. Johnson, (MC), USN, in 1941 by Lt. Comdr. Albert R. Behnke, Jr., (MC), USN, and now by Lt. Comdr. Arthur P. Black, (MC), USNR.

However, lest Navy preen itself too much, attention is invited to the fact that since its establishment in 1916, the prize has been won 21 times by the Army, twice by the Public Health Service, once by the National Guard, once by a civilian, while the above three wins represent Navy's total!

NAVAL MEDICAL RESEARCH INSTITUTE, NATIONAL NAVAL MEDICAL CENTER

The Bureau of Medicine and Surgery has provided research facilities at various locations, including the recently commissioned Naval Medical Research Institute, National Naval Medical Center, Bethesda, Md. The mission of such facilities is to investigate, study, and develop projects and problems coming under the cognizance of the United States Naval Medical Department.

It is hoped that officers and men of the medical department, irrespective of rank and rate, will submit to the Bureau new and original ideas, hypotheses, and problems.

Included in some of the ideas desired are suggestions for the improvement of medical, surgical and dental equipment, installations, and devices; newer methods and measures for the preservation of health and prevention of diseases in naval personnel; recommendations on the treatment, transportation, and hospitalization of personnel casualties, etc.

Members of the naval medical service serving with shore, sea, or air forces should be on the alert to submit original ideas on subjects peculiar to their respective combatant units—such as submarines, deep-sea diving, high-altitude flying, field service, wartime conditions on surface ships, etc.

All new and original ideas, however speculative, will be tabulated and cross-indexed for reference. In exceptional instances, an effort would be made to have the originator given temporary duty where facilities would be available for use in further study and in development of the proposed project.

REFERENCE VOLUME ON SURGICAL TECHNIC

The need of medical officers ashore at isolated stations and afloat on smaller craft, for a reference book on surgical technic, broader and more detailed in scope than a straight textbook on surgery, has been apparent for a long time. Comprehensive as Christopher is with its 1,700 pages and 1,600 illustrations, it cannot be expected to answer the questions of procedure which might harass a medical officer called upon to operate in a field with which he has not been intimately familiar.

As an answer to this, the Bureau has closed a contract with Lippincott for an offset, reduced-type reproduction of Max Thorek's *Modern Surgical Technic* in one volume. The original is in three volumes, with 2,174 unusually excellent illustrations. As a sample of Thorek's thorough coverage he has 45 pages on thyroid and parathyroid with 49 illustrations, almost all of these showing details of operative attack. Christopher has almost the same number of pages, but not one cut of actual procedure.

The original three-volume set was entirely too bulky and weighty, to say nothing of cost, for distribution wholesale to the service. The one-volume edition (a replica except for reduced size of impression) will have the size of one of the volumes of the original set.

The undesirability of the small type was of course duly weighed, but the point is stressed that this is a reference book, rather than a textbook.

The stations and ships not already provided with literature covering this field are urged to apply to the Supply Depot for the new volume.

UROLOGY AWARD

The American Urological Association offers an annual award "not to exceed \$500" for an essay (or essays) on the result of some specific clinical or laboratory research in Urology. The amount of the prize is based on the merits of the work presented, and if the Committee on Scientific Research deems none of the offerings worthy, no award will be made. Competitors shall be limited to residents in urology in recognized hospitals and to urologists who have been in such specific practice for not more than 5 years.

The selected essay (or essays) will appear on the program of the meeting of the American Urology Association, May 31-June 3, 1943, Hotel Jefferson, St. Louis, Mo.

Moore, 899 Madison Avenue, Memphis, Tenn., on or before March 1, 1943.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,

Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

DERMATOLOGIC THERAPY IN GENERAL PRACTICE, by *Marion B. Sulzberger*, Lieutenant Commander, Medical Corps, United States Naval Reserve, and *Jack Wolf, M. D.* Second edition, 632 pages, illustrated. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1942. Price \$5.

Drs. Sulzberger and Wolf's book is a handy size manual and as the title suggests it is devoted largely to treatment of common skin diseases seen in general practice. A little descriptive dermatology and diagnosis is included. The whole purpose is to have a reference work which would be of use to the hard-pressed medical officer who may be separated from opportunity for consultation with the dermatologist.

There is a foreword to this edition by the Surgeon General of the Navy, Rear Admiral Ross T. McIntire, who mentions the plan of establishing departments of dermatology and syphilology in naval hospitals, separate from the urological service. Thus a patient with any skin condition or with syphilis could be treated in this department, the only exception being the neurosyphilitic who would ordinarily be under the neurological service. As the book is mainly devoted to the treatment of skin diseases it is natural that this part should be quite complete. Directions are simple and practical and there are hundreds of prescriptions scattered through the book, which the authors have found successful in their own dermatological practice and which they now pass on to the general practitioner.

A TEXTBOOK OF SURGERY BY AMERICAN AUTHORS, edited by *Frederick Christopher, B. S., M. D., F. A. C. S., Associate Professor of Surgery, Northwestern University Medical School.* Third edition, completely revised and reset. 1,764 pages with 1,538 illustrations on 771 figures. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$10.

This is a third revised edition of this book, and since the publication of the first edition there have been many changes which have been incorporated in the new volume. The book is written by a number of contributors chosen because of their outstanding ability in the subjects which they present. Practically all of them are engaged in teaching surgery in well known medical schools.

This is a one-volume textbook of general surgery. It is divided into 40 chapters, and each chapter is devoted to some specialty of surgery. Each author has taken great pains not to present any debatable or incompletely tried method of surgery, although if there are several equally acceptable methods these have been mentioned. Etiology and pathology as well as diagnosis have been stressed.

The author has added one new chapter—that of War Injuries, written by Dr. R. I. Harris of the University of Toronto. He has covered the subject well in a general manner, and this should be valuable to a civilian surgeon in this country. The use of the sulfonamides has been greatly stressed and one finds now their use in many conditions. In the chapter on carcinoma of the breast, one becomes lost in lengthy footnotes of fine type.

Despite the author's excellent choice of contributors, the reviewer feels that there are too many of them for a one-volume book. He has listed 195, and since there are only 40 chapters many of these men have only written one or two pages. As a consequence, the material suffers from such frequent change of style and method as to both fatigue and confuse the reader. As a glaring example, the chapter on orthopedics has 23 contributors, and the author has so highly specialized this specialty that he has one man write on fractures of the upper shaft of the humerus and another write on fractures of the lower shaft of the humerus and elbow joint. Another author writes on the fracture of the carpal bones, while another writes on fractures of the metacarpals. This almost equals the facetious medical story of the eye specialist who specialized only on the right eye.

At the end of each chapter is a bibliography of the subject so that the book may be used for reference as well as for a text. Illustrations are numerous and fine. The book is also exceptionally well-indexed.

THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS, by *John Albert Key, B. S., M. D., Clinical Professor of Orthopedic Surgery, Washington University School of Medicine; and H. Earle Conwell, M. D., F. A. C. S., Birmingham, Ala.* Third edition, 1,303 pages, illustrated. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$12.50.

In the third edition of this book the authors have brought up to date the latest methods of treatment. A new section on war injuries has been added and the chapter on compound fractures has been rewritten due to the introduction and use of the sulfonamides in the

treatment of these injuries. The material on the treatment of fractures and dislocations has also been revised, as have the chapters on fractures of the jaw and face, skull fractures and brain trauma.

The author has described the forms of treatment which he has found to be reliable and practicable so that as one reads through the book he is able to learn the little "tricks" that make the practice of orthopedics successful. He describes the various fractures which cause injury to the soft tissues and points out that this injury is more important than the fracture itself. Complications and how to treat them are also mentioned. There is a special chapter on emergency treatment. He has included a chapter on medico-legal aspects in fracture cases as well as a chapter on the workmen's compensation laws.

The book is well illustrated with photographs, drawings, and tables. The index is very complete, the type of print is such that it is easy reading, and each paragraph is headed by bold-faced type. This book is an outstanding contribution of its kind and it is recommended for the student, general practitioner, and surgeon.

OPERATIVE SURGERY, Including Anesthesia, Pre- and Post-operative Treatment, Principles of Surgical Technic, Blood Transfusion, and Abdominal Surgery, edited by *Frederick W. Bancroft, A. B., M. D., F. A. C. S., Associate Clinical Professor of Surgery, Columbia University*, and *3½ contributing authors*. 1,102 pages, 924 illustrations. D. Appleton-Century Co., Inc., New York, publishers, 1941. Price \$10.

This is a new one-volume book which has been assembled from the material of outstanding authors and edited by Dr. Bancroft. The author has presented surgical treatment of abdominal diseases and of such important subjects as anesthesia and its various types, pre- and post-operative treatment, blood transfusions, and the fundamental principles of surgical technic. The material is practically all surgical treatment and does not concern etiology, pathology, or diagnoses as it is assumed that the diagnosis has been made. However, when necessary the author has included a differential diagnosis. He has emphasized the best methods of doing surgery for the various surgical conditions, and has a number of times discouraged unnecessary surgery.

The book is divided into 20 sections and each section is devoted to some specialty of surgery, such as surgery of the mouth, of the esophagus, surgery of the small intestine, etc. In addition to these specialized procedures, he discusses radiotherapy, vaccines, and drug therapy, indications and contraindications for operation, and the dangers, complications, and prognosis of each procedure.

The book is well indexed, the print makes it easy reading, and there are references at the end of each chapter. The book is well illustrated and there are a number of colored plates.

PHYSIOLOGY AND ANATOMY, by *Esther M. Greisheimer, B. S. in Education, M. A., Ph.D., M. D., Professor of Physiology, Woman's Medical College of Pennsylvania.* 822 pages, 474 illustrations, 4th edition, revised and reset. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.50.

This book, an excellent presentation of anatomy and physiology, is organized into five major units: (1) The Body as an Integrated Whole, (2) The Erect and Moving Body, (3) Integration and Control of the Body by the Nervous System, (4) Maintaining the Metabolism of the Body, (5) The Reproductive System.

Each unit has carefully selected, well-organized and clearly stated material which is thoroughly supplemented by comprehensive and visual-aid illustrations.

Additional features, such as practical considerations at the end of each chapter, an excellent list of references, and a good table of contents and glossary, strengthen the major purposes and objectives of the edition.

Altogether, the revision has made this a fine text which should be of special value and interest to physiotherapists who desire to review the subject of anatomy and physiology as well as to student and graduate nurses.

THE NATIONAL FORMULARY, Seventh Edition, Prepared by *the Committee on National Formulary, by Authority of the American Pharmaceutical Association.* 690 pages. Official from November 1, 1942. Published by The American Pharmaceutical Association, Washington, D. C., 1942. Price \$6.

This contains 97 new monographs which have been removed from the U. S. Pharmacopoeia and transferred into the Formulary. In addition to this there are many new preparations, i. e., Cherry and Raspberry Juice for making syrups, Zinc Eugenol Cement, Neocalamine Lotion and Ointment, and Pectin. There is a very extensive section in this edition on the "Reagents and Preparations for Use in the Clinical Laboratory"—an extremely valuable feature.

Among the preparations which have been removed from the Pharmacopoeia and placed in the Formulary are many with which medical officers of the Navy are particularly well acquainted. One is good old brown mixture—*Mistura Opii et Glycyrrhizae Composita*. Several other preparations famous in the history of medicine and pharmacy are among additions to this Formulary by deletion from the new Pharmacopoeia.

AMERICAN POCKET MEDICAL DICTIONARY, edited by *W. A. Newman Dorland, A. M., M. D., Member of the Committee on Nomenclature and Classification of Diseases of the American Medical Association; Editor of the "American Illustrated Medical Dictionary."* 1,037 pages, 17th edition, thoroughly revised. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$2.50.

The new seventeenth edition of the American Pocket Medical Dictionary is a miniature model of the larger Dorland in outside appear-

ance. It is a "pony" pocket medical dictionary in a sense that it resembles the full size horse but is just smaller. A great number of pages, 1,037, has been included by using a thin paper, deleting all illustrations, and reducing the definitions to as few words as possible. Still the definitions are adequate. Thus, bipalatinoid is properly defined as "A gelatin capsule with two compartments" and bipara as "A woman who has borne two children at different labors." The number and extent of tables has also been considerably reduced. Though a little large for the pocket, it is just right for the hand. It is a fine ready reference medical dictionary, particularly for the medical and pharmaceutical student.

STEDMAN'S PRACTICAL MEDICAL DICTIONARY, by *Stanley Thomas Garber, B. S., M. D., University of Cincinnati, College of Medicine*. Fifteenth revised edition with etymologic and orthographic rules. 1,257 pages. The Williams & Wilkins Co., Baltimore, Md., publishers, 1942. Price \$7.50.

This is one of the best known of the standard medical dictionaries used in this country. It has been revised by Dr. Stedman's nephew, who has attempted to retain all the excellent features which have made this dictionary a favorite with many medical men and yet to bring it thoroughly up to date.

Every book has characteristics which distinguish it from other books, though it would seem that dictionaries would show very few differences. Some of the special features of this dictionary are the section on medical etymology, the printing of the Greek roots of medical words in a special type, an appendix covering weights and measures, tables of chemical elements, pathogenic microparasites, temperature and barometer scales. A practical feature is the brief description of the technic of clinical laboratory tests.

It partakes also of the character of a pharmaceutical dictionary with all the official pharmaceutical preparations listed. For example, under the title of "liniment" each one is listed alphabetically with its composition.

The type and illustrations are excellent; in fact they could scarcely be better. A great many of the illustrations, indeed most of them, are new.

A TEXTBOOK OF GYNECOLOGY, by *Arthur Hale Curtis, M. D., Professor and Chairman of the Department of Obstetrics and Gynecology, Northwestern University Medical School*. 723 pages with 401 illustrations. Fourth edition, reset. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$8.

This edition has many new features, including the use of the sulfa drugs in the therapy of gonorrhea. Their use alone has brought about marked changes in modern gynecology. A particular feature is the chapters on the displacements of the uterus. It represents a remarkably clear account of these conditions. Ovarian and uterine tumors

have also been dealt with adequately, and the treatment including the operative treatment of carcinoma of the cervix is especially fine.

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION, edited by *Richard M. Hewitt, B. A., M. A., M. D.; A. B. Nevling, M. D.; John R. Miner, B. A., Sc. D.; James R. Eckman, A. B.; and M. Katharine Smith, B. A.* 1,009 pages, illustrated, Volume XXXIII, 1941, published May, 1942. W. B. Saunders Co., publishers. Price \$11.50.

This volume contains abstracts, condensations, and reprints of articles published during the year by members of the staff of the well-known Rochester institution. The otherwise routine sections under which articles appear, reflect the spirit of the times by the inclusion of a section on aviation medicine in which 10 articles will be found. Illustrations are freely used throughout the book and complete indexes make the material readily available. Articles published by staff members during the year and not abstracted or reprinted in this volume are included by title.

MICROBIOLOGY APPLIED TO NURSING, A Combined Textbook and Laboratory Guide, by *Jean Broadhurst, Ph. D., Professor of Bacteriology, Teachers College, Columbia University*, and *Leila I. Given, R. N., M. S., Director of Nursing Education, State Board of Health, Madison, Wisconsin.* 653 pages, illustrated with 314 illustrations and 2 color plates, 4th edition revised. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.

This fourth edition, organized in accordance with the unit plan and giving a thorough scientific introduction to the subject, contains much comprehensive up-to-date material, such as the chapter on Important Historical Phases of Microbiology, Suggestions for Study, and Assimilation Tests.

The chapter on Vaccines, Immune Serums, and Tests Related to Disease and Immunity, in addition to the section dealing specifically with the Casual Agents of Communicable Diseases, is especially noteworthy.

Excellent photographs and illustrations, combined with a fine glossary and references, all tend to make this well-written book useful as a text for both student and graduate nurses.

SEROLOGY IN SYPHILIS CONTROL, Principles of Sensitivity and Specificity, With an Appendix for Health Officers and Industrial Physicians, by *Reuben L. Kahn, M. S., D. Sc., Director of Clinical Laboratories and of Serologic Consultation Service, University of Michigan Hospital.* 206 pages. The Williams & Wilkins Co., Baltimore, Md., publishers, 1942. Price \$3.

This book by a recognized authority in the field of serology is very timely because of the tremendous amount of blood testing for syphilis in present day civil and military life. The material presented is entirely that of underlying principles without any attempt being made to give or discuss technical details. The chapter on the super-sensitive test (presumptive test) is particularly interesting at this

time because the Navy has recently approved the use of the Presumptive Kahn as a screen test. Other timely subjects, such as the use of multiple tests and the public health aspects of the serological tests for syphilis are also discussed in the clear, lucid manner of the author. The book will be of great value to laboratory men generally and particularly to serologists who are required to render serologic opinions in doubtful cases.

MORRIS' HUMAN ANATOMY, A Complete Systematic Treatise, edited by *J. Parsons Schaeffer, A. M., M. D., Ph. D., Sc. D., Professor of Anatomy and Director of the Daniel Baugh Institute of Anatomy, Jefferson Medical College, Philadelphia.* 1,635 pages with 1,155 illustrations. Tenth edition. The Blakiston Co., Philadelphia, Pa., publishers, 1942. Price \$12.

The four standard textbooks of anatomy most familiar to English-speaking readers are Cunningham, Gray, Piersol, and Morris. The last two are American books. Each of these works is complete in its descriptions of human gross anatomy. They have, however, certain clearly defined characteristics which make them different from one another.

One of the outstanding features of this edition of Morris' Anatomy is the fine presentation of developmental anatomy. Some of the earlier editions of Morris' were criticized because of the weakness of the section on the nervous system. The present edition, however, has eliminated such criticism for it now constitutes one of the outstanding sections of the book. Another, perhaps the best in any English language anatomy, is the section on the lymphatic system. The illustrations, so important a part of a textbook of gross anatomy, could not be surpassed.

THE HAND, Its Disabilities and Diseases, by *Condict W. Cutler, Jr., M. D., F. A. C. S., Associate Surgeon, Roosevelt Hospital.* 572 pages with 274 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$7.50.

The hand is so important a part of the human anatomy that it is not surprising that entire books have been written upon the subject of its injuries and diseases. The present work of Dr. Cutler goes beyond the usual book which commonly deals with injuries. In addition to traumatic conditions, however, this book goes into the subject of deformities, tumors, and the various diseases which may affect the hand. Of great interest is the fact that there is a considerable amount of material in it on the symptoms appearing in the hand, in certain constitutional diseases such as gout, rickets, heart disease, and various nervous diseases. The surgical section dealing particularly with the acute infections of the hand makes up nearly half of the book. The illustrations are excellent, the book is strongly and attractively bound.

ABDOMINAL OPERATIONS, Volumes I and II, by *Rodney Maingot, F. R. C. S. Eng.*, *Senior Surgeon to the Southend General Hospital, and to the Royal Waterloo Hospital, London.* 1,385 pages, illustrated. D. Appleton-Century Co., Inc., New York, publishers. Price \$18.

This work is composed of two volumes. The first volume deals with abdominal incisions, operations on the stomach and duodenum, spleen, pancreas, gallbladder, and bile duct. The second volume describes conditions of the liver, appendix, peritoneum, mesentery, omentum, external hernia, intestines, and postoperative chest complications. In both volumes the author has given the preoperative and postoperative treatment; the choice of operation in each case; difficulties and dangers which sometimes arise during operation; the immediate and remote reasons of the various methods described; the clinical, practical, and other aspects of destructive lesions of the abdominal viscera; and other problems in abdominal surgery.

Both volumes are very well illustrated with drawings, photographs and color photographs. The drawings are especially good and show the detailed anatomy. The print is large, the lines well-spaced, and the type of paper makes it easy reading.

If necessary, the author could have made this into one volume.

For the young surgeon, the student, and the specialist, these books are recommended.

ATHLETIC INJURIES, Prevention, Diagnosis and Treatment, by *Augustus Thorne-dike, M. D.*, *Surgeon in the Department of Hygiene, Harvard University.* 216 pages, illustrated with 105 engravings. Second edition, thoroughly revised. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$3.

This is a small handbook giving the prevention, diagnosis, and treatment of athletic injuries. In the first part of the book the author covers briefly the anatomy of the human body as related to physical exercise. He points out the results, shows the importance of preventing injuries by correct training, and provides special procedures for prevention of such measures. The second and third parts deal with the diagnosis and treatment of special injuries incidental to athletics.

The book is well illustrated by photographs, drawings, and tables. There is an extensive bibliography and it is well indexed.

MANUAL OF STANDARD PRACTICE OF PLASTIC AND MAXILLOFACIAL SURGERY, prepared and edited by *the Subcommittee on Plastic and Maxillofacial Surgery of the Committee on Surgery of the Division of Medical Sciences of the National Research Council, and Representatives of the Medical Department, U. S. Army.* 432 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$5.

This volume is one of a series developed under the auspices of the National Research Council to furnish the medical departments of the Army and Navy with compact presentations of necessary infor-

mation in the field of military surgery. It presents in condensed form the essentials of management of casualties in this field. It has been prepared by the leaders of the profession, and there can be no doubt that it conveys the very latest and most authoritative information.

Many of the old plastic procedures, reproduced in the textbooks for generations, are completely useless, being planned on a purely geometrical basis with no regard for nerve or blood supply or muscular action. These are thoroughly debunked in this manual. Emphasis is laid on the necessity of planning the whole series of operations, and the details of each stage, before any operative work is commenced.

The section on reconstructive surgery is by Ferris Smith. That on maxillary surgery is by L. C. Fairbank, Roy A. Stout, Robert Ivy and Joseph D. Eby. Maxillofacial Prosthesis is described by P. C. Lowery. The discussion on anesthetic technics is by Fairbank, Stout, and Frederic Haugen.

This volume is an important contribution to our war effort. It should be in the library of every naval hospital, whether fixed or mobile, and should accompany all expeditionary forces.

SYNOPSIS OF ANO-RECTAL DISEASES, by *Louis J. Hirschman, M. D., F. A. C. S.* 315 pages with 182 text illustrations and 12 color pages. Second edition. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price, \$4.50.

This is an excellent little book on rectal diseases. It is of such a size that it can easily be put into the doctor's bag or a pocket. It is the second edition in 4 years, which speaks well for its popularity. The author has presented the technic of diagnosis and of therapeutic measures. He has made diagnosis easy in that he does not require complicated and expensive electrical instruments to make such a diagnosis. He has kept in mind, in writing this book, to present the material in such a way so that rectal diseases can be treated safely and successfully outside the field of a specialist.

This little book is well indexed and recommended to anyone treating rectal diseases.

ROSE & CARLESS MANUAL OF SURGERY, American (Sixteenth) Edition, edited by *William T. Coughlin, B. S., M. D., F. A. C. S.*, from the sixteenth English edition by *Cecil P. G. Wakeley, D. Sc., F. R. C. S., F. R. S. E., F. R. S. A., F. A. C. S., F. R. A. C. S., Fellow of King's College, London*; and *John B. Hunter, M. C., M. Chir. Cantab., F. R. C. S. Eng.* 1,756 pages, illustrated. The Williams & Wilkins Co., Baltimore, Md., publishers, 1940. Price \$9.

This reviewer was brought up on this manual of surgery, which was the standard textbook of the medical school which he attended, as it has been and still is the text of many medical schools. Furthermore it has been the text to which many medical men have turned for assistance and advice in all sorts of surgical emergencies and conditions with which they have been confronted in active practice. Rose and

Carless has always been a very practical book. This edition has several interesting features, a section on amputations, one on anesthesia, gynecological surgery, surgical conditions of the ear, surgical conditions of the eye, surgery in the tropics, and war surgery.

CARCINOMA AND OTHER MALIGNANT LESIONS OF THE STOMACH, by *Waltman Walters, B. S., M. D., M. S. in Surgery, D. Sc., F. A. C. S., Surgeon, Mayo Clinic; Howard K. Gray, B. S., M. D., M. S. in Surgery, F. A. C. S., Surgeon, Mayo Clinic; and James T. Priestley, B. A., M. D., M. S. in Experimental Surgery, Ph. D. in Surgery, F. A. C. S., Surgeon, Mayo Clinic; and Associates in the Mayo Clinic and Mayo Foundation, Rochester, Minnesota.* 576 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$8.50.

This book is the result of a review of all cases seen at the Mayo Clinic, from 1907 to 1938, with a diagnosis of malignant lesion of the stomach. It is divided into 23 chapters and each chapter is written by an outstanding man of the clinic. The various authors describe roentgenographic diagnosis, gastroscopy, the clinical features of malignant stomach, indications for treatment, and nutritional deficiencies associated with such lesions. There is an excellent chapter on preoperative treatment, and one on the selection of anesthesia for the particular patient. There are 2 chapters on pathological considerations, one written by Dr. A. C. Broders and one by Dr. W. C. MacCarty. The postoperative treatment is well covered and the chapter on prognosis is excellent due to their high percentage of follow-up cases.

The remaining chapters in the book deal with the indications for operative procedure for carcinoma of the stomach and the various types of operations. Dr. Walters has written this material in a clear and concise manner so that the technic given is easy to understand and not complicated by voluminous descriptions. The illustrations showing his technic are outstanding. There are other excellent photographs and tables as well as a complete index. The type of print on non-glossy paper makes it easy reading. This is a good book for the surgeon who does gastric surgery.

THE PATHOLOGY OF TRAUMA, by *Alan Richards Moritz, M. D., Professor of Legal Medicine, Harvard Medical School.* 386 pages with 117 engravings. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$6.

Although many medicolegal books are devoted to trauma, this is the first one devoted primarily to the pathological aspect of lesions produced by mechanical violence. This book is timely, as the spread of conflict throughout the world has further augmented the need for better understanding of the subject. The author has surveyed the causes of mechanical agencies, the manner in which they operate to produce functional and organic disturbances, the pathological characteristics of their resulting lesions, the pathogenesis of their compli-

cations and sequelae, and certain types of evidence of medicolegal interest. He describes the wound produced by various mechanical agencies, such as bullet wounds, injuries resulting from high explosives, and injuries to various organs of the body.

There is an extensive bibliography at the end of each chapter. It is well indexed and illustrated.

HOW TO LIVE, Rules for Healthful Living Based on Modern Science, by *Irving Fisher, LL. D., Emeritus Professor of Economics, Yale University*; and *Haven Emerson, M. D., Professor of Public Health Practice, Columbia University*. Twentieth edition, completely revised and rewritten. 422 pages. Funk & Wagnalls Co., New York, publishers, 1942. Price \$2.50.

This is the twentieth edition of a popular book written by an economist and a distinguished American authority on public health. It is intended as a guide for laymen on the practical rules of modern hygiene. Food habits, use of alcohol and tobacco, exercise, and avoidance of certain diseases are included in it. There is a considerably larger share of common sense contained in the advice given than is usual in books of this character, too many of which are full of food, exercise, or other fads.

DISEASES OF METABOLISM, Detailed Methods of Diagnosis and Treatment, A Text for the Practitioner, edited by *Garfield G. Duncan, M. D., Associate Professor of Medicine, Jefferson Medical College, Philadelphia, Pa.*; and contributors. 985 pages, illustrated. W. B. Saunders Company, Philadelphia, Pa., publishers, 1942. Price \$12.

In this book the diseases of metabolism are grouped under carbohydrate, protein, lipid, and mineral metabolism, followed by careful studies of waterbalance, the effects of anemias on metabolism, and of avitaminoses. There are then special chapters on obesity, undernutrition, gout, and diabetes. Particularly important is the study of the latter disease in the pregnant woman and in childhood. The book concludes with a number of excellent tables on foods, heights and weights, and an appendix dealing with the determination of basal energy requirements.

ELECTROTHERAPY AND LIGHT THERAPY, With the Essentials of Hydrotherapy and Mechanotherapy, by *Richard Kovacs, M. D., Professor of Physical Therapy, New York Polyclinic Medical School and Hospital*. 735 pages illustrated with 314 engravings and a color plate. Fourth edition, thoroughly revised. Lea and Febiger, Philadelphia, Pa., publishers, 1942. Price \$8.

This is a revision of Dr. Kovacs' standard and popular text and differs only from earlier editions in having been brought completely up to date without disturbing the excellent features which have made this so extensively a used book by the medical profession. There are 81 new illustrations and the latest progress in iontophoretic therapy has been included.

PSYCHOLOGIC CARE DURING INFANCY AND CHILDHOOD, by *Ruth Morris Bakwin, B. A., M. A., M. D., Assistant Clinical Professor of Pediatrics, New York University College of Medicine*; and *Harry Bakwin, B. S., M. D., Associate Professor of Pediatrics, New York University College of Medicine*. 317 pages. D. Appleton-Century Co., Inc., New York, publishers, 1942. Price \$3.50.

It is too bad that this book cannot be required reading for all parents as well as all physicians. Unfortunately, all parents do not possess the intelligence and education necessary for the understanding of the book. Still, although written primarily for physicians, it is a valuable book for any intelligent person who has to deal with children. Particularly to be commended in it is the common sense attitude taken in regard to all features of the subject. The absence of trite and banal assumptions is to be noticed. Both the authors are experienced pediatricians.

ESSAYS ON THE APPLIED PHYSIOLOGY OF THE NOSE, by *Arthur W. Proetz, A. B., M. D., Professor of Clinical Otolaryngology in the Washington University School of Medicine*. 395 pages, illustrated. Annals Publishing Co., St. Louis, Mo., publishers, 1942. Price \$7.

This book is one of interest primarily to the rhinologist and the physiologist. Much of the material is academic and it will no doubt arouse others to further research in nasal function.

The last two chapters of this text have a broader appeal dealing with nasal treatment and nasal surgery.

Of interest to all medical men is the part dealing with immunization against the common cold. Subcutaneous injections of "cold shots" for which the laity clamor is ineffective in most cases. Proetz states that Walsh has found 74 percent effective results by the local intranasal application of vaccines. The vaccines were made from cultures obtained from numerous patients in ear, nose, and throat clinics who were in the acute and chronic stages of upper respiratory infection. From these cultures stock suspensions were made and others were added from time to time as fresh infections appeared. The concentrated vaccines were mixed in the following proportions:

	<i>Parts</i>
Staphylococcus albus—hemolytic and nonhemolytic—of each	1
Staphylococcus—hemolytic	1
Streptococcus a, b, and g—of each	2
Pneumococci, all types—of each	1
Diphtheroid bacilli	1
Friedländer's bacillus	2
B. influenzae	2

The vaccines were applied by the patient with an atomizer each night for three weeks, and again after one week's rest for two weeks, after which they were continued for alternate bi-weekly periods from September to May.

In the part dealing with nasal surgery, one can summate the whole theme by stating that normal nasal aeration makes a healthy nose.

QUICK REFERENCE BOOK FOR NURSES, Compiled and Arranged from Various Sources, by *Helen Young, R. N.*, with the assistance of *Georgia A. Morrison, R. N.*, and *Margaret Eliot, R. N.* 560 pages, 4th edition. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$2.

This fourth edition of a book which has long been popular among nurses contains many new things. Popular and official names of drugs which meet the requirements of the new Pharmacopeia, material on the sulfonamide drugs, and many technics in connection with surgical nursing are included. The book is small, almost pocket size, and is thumb indexed like a dictionary. It is packed with information and there are no unnecessary words. It is said that every nurse sent out by one of the British dominions has this book issued to her as a part of her kit, and there would seem to be merit in the idea of equipping every nurse with this or some similar work.

ANAESTHETICS AFLOAT, by *Surgeon Lieutenant Commander Ronald Woolmer, R. N. V. R., B. A., B. M. B. Ch. (Oxon.), D. A., Anaesthetic Specialist, R. N. Medical Service*; with an introduction by *Surgeon Captain H. D. Drennan, D. S. O., R. N.* 120 pages with 18 illustrations. H. K. Lewis & Co., Ltd., London, publishers, 1942. Price 6/- net.

This is a little handbook to review the bare essentials of anaesthetics. Very briefly the author gives emphasis to the use of ether and chloroform, both of which come to the fore in military surgery, particularly in time of war because of their simplicity and the fact that they can be given without complicated apparatus or very highly specialized training. There is no superfluous matter in the book.

FIRST AID IN THE ROYAL NAVY, Published by *His Majesty's Stationery Office*, 1941, and to be purchased directly from H. M. Stationery Office at York House, Kingsway, London, W. C. 2, or through any bookseller. 117 pages. Price 2s. 0d. net.

This is a new edition of the official handbook on first aid used in the British Navy. The material is grouped into four lectures: *First*—Bones: Fractures and their treatment; *Second*—Circulation of the blood: Bleeding and its treatment; *Third*—Wounds, including burns, treatment of the wounded, stretchers and their use; *Fourth*—Drowning, poisoning, various forms of unconsciousness, various accidents. Of considerable interest is what the author describes as the watchword of each lecture. This is a sort of motto. For example, for the first lecture it is "Do not allow a simple fracture to become a compound fracture." The watchword for the second lecture, which is on control of hemorrhage, is "In arterial bleeding, press your finger on the bleeding spot." The watchword of the fourth lecture on drowning is "In treating an apparently drowned person, act very promptly, keep cool and never give up hope."

ESSENTIALS OF CHEMISTRY, With Laboratory Manual, by *Gretchen O. Luros, M. A., Department of Nursing Education, Cass Technical High School, Detroit, Michigan*; and *Florence Oram, B. S., M. A., R. N., Assistant Director, School of Nursing, Michael Reese Hospital, Chicago, Illinois*; *Science Adviser, Jean Broadhurst, Ph. D., Professor of Bacteriology, Teachers College, Columbia University, New York City*. 578 pages, illustrated, 4th edition. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.

This would make an excellent text for a course in high school chemistry or a similar secondary school, although it was primarily designed as a text for nurses. The elements of both inorganic and organic chemistry are given, and elementary matter on biological chemistry. Among the features of the book of particular value are a series of exercises and review questions, an interesting set of tables showing tables of elements, a periodic table, a table of valence and solubility, poisons and their antidotes, and a section dealing with the removal of common stains. It has a good index and bound in the back of the book is a sort of laboratory manual. The volume is very attractively bound and the inside of the cover is interestingly decorated with some of the old alchemists' symbols.

ESSENTIALS OF MEDICINE, by *Charles Phillips Emerson, Jr., M. D., Research Fellow in Medicine, Harvard Medical School*, and *Jane Elizabeth Taylor, R. N., B. S., M. Ed., Assistant Professor of Medical Nursing, Yale University School of Nursing*. 14th edition, 892 pages, 195 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price, \$3.25.

The fourteenth edition of this widely used text, thoroughly revised and re-edited to conform to the unit plan as suggested by the curriculum guide so as to cover the diseases which are included in the master list of disease conditions for medical nursing, has two main objectives: (1) To provide the nurse with an adequate source of knowledge pertaining to medical diseases; (2) to acquaint her with the problems of nursing relative to prevention, recognition, and treatment.

The revision has increased the scope and usefulness of an already fine book by adding or retaining such distinctive features as (1) additions of newer as well as the rewriting of older material to conform with medical advances; (2) an excellent presentation of nursing technic which coordinates well with the surgical nursing discussion of *Elisson, Fergusson, and Farrand*; (3) the utilization of the front and back pages of the book for a list of commonly used terms, suffixes, and prefixes which may be used in making medical words; (4) a practical list of references given with each unit; a fine, adequate index; (5) numerous, well-selected illustrations; (6) convenient size; clear, easily read type; attractively bound.

COMMUNICABLE DISEASE NURSING, by *Theresa I. Lynch, R. N., Ed. D., Instructor in Education, New York University*. 678 pages with 156 text illustrations and 5 color plates. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$3.75.

In this new volume on communicable disease nursing, the care and control of communicable diseases is covered in a most thorough, well organized manner.

The topic is taken up in three parts, each of which is complete in itself. Part I gives a clear orientation to communicable diseases. Part II describes the medical aspects and nursing care. Each disease is treated in a separate chapter according to definition, nursing care, and community nursing. Part III emphasizes the application of communicable disease nursing in relation to the community.

The book contains a well-selected glossary, is adequately indexed, and each chapter is followed by excellent references and suggested readings. The numerous graphic illustrations and color plates are especially noteworthy.

This text should be recommended for students and teachers of nursing because of its presentation of sound principles and up-to-date nursing technics.

THE RAT IN LABORATORY INVESTIGATION, by *a Staff of Thirty Contributors*. Edited by *John Q. Griffith, Jr., M. D., Associate in Medicine, School of Medicine, University of Pennsylvania*; and *Edmond J. Farris, Ph. D., Executive Director and Associate in Anatomy, Wistar Institute of Anatomy and Biology*. 488 pages with 178 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$7.50.

This book is a complete exposition of the subject of the rat as a laboratory animal, written by a staff of 30 contributors for the instruction and guidance of laboratory and research workers. Technical procedures are described in detail. The anatomy and physiology of the various systems are comprehensively covered, together with metabolism and various experimental procedures in each. The book is a valuable contribution to scientific literature and will be of great value to all research workers. It will also be of value as a guide for those working with or raising other small laboratory animals for experimental purposes.

A MANUAL OF PHARMACOLOGY, And Its Applications to Therapeutics and Toxicology, by *Torald Sollmann, M. D., Professor of Pharmacology and Materia Medica in the School of Medicine of Western Reserve University, Cleveland*. Sixth edition, entirely reset. 1,298 pages. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$8.75.

This reviewer is a little prejudiced in favor of Sollmann's Pharmacology, for it was from this book that he began the study of

pharmacology as a medical student more than 30 years ago. Since then, he has become acquainted with many other books on the subject, many of them excellent, one or two the equal of it—Cushney's textbook for example. I do not believe, however, that any book could be classed as superior to it as a clear, comprehensive manual to which a medical man can refer. The action of medicinal agents, channels of absorption and excretion, untoward effects, dosages, and preparations, all are given. It is a book that has always been and still remains one of the best American textbooks in this field.

A DIABETIC NOTEBOOK FOR USE OF THE PATIENT, by *Blair Holcomb, M. D.*; *Roger Holcomb, Lieutenant Commander, Medical Corps, U. S. N. R.*; and *E. Murray Burns, Major, Medical Reserve Corps, U. S. A.* Second edition, 132 pages. Privately printed by Arcady Press, Portland, Oreg. Price \$1.50.

The authors have prepared this book for the benefit of the diabetic patient who is undergoing training. It is to be used in conjunction with lectures.

There are three sections to the book. Section A includes the basic theoretical material which is necessary for each diabetic patient to know in order to manage his illness. Section B includes the technical material regarding diet, diet calculation, the technic of insulin injection and of urine testing. Section C consists only of cooking recipes.

Most of the material, in the main, is presented in outline form. There are numerous blank pages throughout the book to be used for notes by the patient. There is also a frank discussion of the complications of diabetes.

It is true that lay patients cannot be made into physicians by a short series of diabetic lectures, but the authors believe that sufficient education can be given to permit the patient to work in cooperation with the physician and live a normal span of life. The book is well indexed and contains excellent tables and charts.

THE DIVISION OF PREVENTIVE MEDICINE

Commander T. J. Carter, Medical Corps, United States Navy, in charge

TOXIC EFFECTS OF ARSENICAL COMPOUNDS

AS EMPLOYED IN THE TREATMENT OF DISEASES IN THE UNITED STATES NAVY, 1941

By C. S. STEPHENSON, Rear Admiral, Medical Corps, United States Navy, M. W. CHAMBERS, Pharmacist, United States Navy, and MRS. LAURA T. ANDERSON, Junior Administrative Assistant, Bureau of Medicine and Surgery.

Since November 1924 medical officers of the Navy have been required to make monthly reports of the number of doses of arsenicals administered and a separate report of each case in which ill effects are noted. During the 17 years, 1925-41, in which this information has been compiled, 1,792,413 doses of arsenicals have been administered and 1,118 reactions have been reported.

Previous articles dealing with the information obtained from these reports have been published in the following issues of this BULLETIN:

September 1925.	October 1933.	January 1937.	January 1940.
January 1927.	October 1934.	October 1937.	October 1940.
January 1929.	January 1935.	January 1938.	January 1941.
July 1930.	October 1935.	October 1938.	October 1941.
October 1931.	January 1936.	January 1939.	January 1942.
October 1932.	October 1936.	October 1939.	October 1942.

Cases of arsenical dermatitis occurring during the year 1941 were published in the October 1942 issue.

The present article includes all cases, except arsenical dermatitis, which were reported during the year 1941. Comparative figures from the experience of previous years are also presented.

TABLE 1.—*Arsenical reactions, 1941*

Classification	Neoarsphenamine and Mapharsen			
	Mild	Severe	Fatal	Total
Arsenical dermatitis ¹	6	4	0	10
Reactions of minor importance	5	0	0	5
Jarisch-Herxheimer	2	0	0	2
Liver damage	1	1	0	2
Hemorrhagic encephalitis ²	0	0	1	1
Gastrointestinal	0	1	0	1
Vasomotor phenomena	1	0	0	1
Total	15	6	1	22

¹ Case histories were published in the October 1942 number of the Bulletin. 14 of the above reactions (11 mild, 2 severe, 1 fatal) were caused by mapharsen.

² A cerebral hemorrhage occurred following the administration of mapharsen.

TABLE 2.—*Arsenicals administered during the year 1941 for all diseases*

Drug	Doses (grams)				
	0.9 to 3	0.9	0.6 to 0.9	Less than 0.6	Total
Bismarsen:					
Navy	0	0	0	54	54
All others	0	0	0	132	132
Mapharsen:					
Navy	0	0	0	78,089	78,089
All others	0	0	0	7,396	7,396
Neosarsphenamine:					
Navy	0	204	9,049	3,161	12,414
All others	0	19	866	2,870	3,755
Sulfarsphenamine:					
Navy	0	0	63	0	63
All others	0	1	109	371	481
Tryparsamide:					
Navy	1,963	0	0	0	1,963
All others	1,356	0	0	0	1,356
Total	3,319	224	10,087	92,073	105,703

TABLE 3.—*Arsenicals administered during the 10-year period, 1932-41, for all diseases*

Drug	Doses (grams)				
	0.9 to 3	0.9	0.6 to 0.9	Less than 0.6	Total
Acetarsonic:					
Navy	0	0	0	166	166
All others	0	0	76	729	805
Arsphenamine:					
Navy	0	0	149	10,297	10,446
All others	0	0	7	706	713
Bismarsen:					
Navy	0	0	0	2,029	2,029
All others	0	0	1	1,603	1,604
Mapharsen: ¹					
Navy	0	0	0	259,527	259,527
All others	0	0	0	29,057	29,057
Neosarsphenamine:					
Navy	0	5,440	297,113	381,268	683,821
All others	0	836	38,846	135,999	175,681
Silver arsphenamine:					
Navy	0	0	0	350	350
All others	0	0	0	204	204
Sulfarsphenamine:					
Navy	0	18	397	7,472	7,887
All others	0	8	404	13,414	13,826
Tryparsamide:					
Navy	34,484	0	0	13	34,497
All others	16,860	0	2	8	16,870
Total	51,344	6,302	336,995	842,842	1,237,483

¹ First administered in 1935.

TABLE 4.—Deaths and severe reactions following the administration of 1,355,058 doses of neoarsphenamine, 1925-41; ratio of deaths and severe reactions to doses

	Deaths		Severe reactions		Deaths and severe reactions	
	Num-ber	Ratio to doses, 1 to—	Num-ber	Ratio to doses, 1 to—	Num-ber	Ratio to doses, 1 to—
Hemorrhagic encephalitis.....	16	84,691	1	1,355,058	17	79,709
Arsenical dermatitis.....	13	104,235	201	6,742	214	6,332
Vasomotor phenomena.....	6	225,843	57	23,773	63	21,509
Blood dyscrasias.....	8	169,382	20	67,753	28	48,395
Acute renal damage.....	2	677,529	5	271,012	7	193,580
Acute yellow atrophy of the liver.....	2	677,529	0	—	2	677,529
Vascular damage (probable renal hemorrhage).....	1	1,355,058	0	—	1	1,355,058
Liver damage.....	1	1,355,058	24	56,461	25	54,202
Jarisch-Herxheimer.....	0	—	2	677,529	2	677,529
Gastrointestinal.....	0	—	5	271,012	5	271,012
Polynuritis.....	0	—	1	1,355,058	1	1,355,058
Borderline hemorrhagic encephalitis.....	0	—	1	1,355,058	1	1,355,058
Arsenical neuritis.....	0	—	1	1,355,058	1	1,355,058
Optic neuritis.....	0	—	1	1,355,058	1	1,355,058
Classification undetermined.....	1	1,355,058	0	—	1	1,355,058
Total.....	50	27,101	319	4,248	369	3,672

TABLE 5.—Deaths following administration of arsenical compounds, 1919-41

Year	Arsphen-amine	Neoarsphen-amine	Maphar-sen	Total	Year	Arsphen-amine	Neoarsphen-amine	Maphar-sen	Total
1919.....	3	0	0	3	1932.....	0	4	0	4
1920.....	1	1	0	2	1933.....	0	7	0	7
1921.....	3	1	0	4	1934.....	0	3	0	3
1922.....	0	4	0	4	1935.....	0	2	0	2
1923.....	0	1	0	1	1936.....	0	3	0	3
1924.....	1	2	0	3	1937.....	0	1	0	1
1925.....	0	2	0	2	1938.....	0	3	0	3
1926.....	0	4	0	4	1939.....	0	4	0	4
1927.....	1	4	0	5	1940.....	0	1	0	1
1928.....	0	6	0	6	1941.....	0	0	1 ¹	1 ¹
1929.....	0	3	0	3	Total.....	9	59	1	69
1930.....	0	3	0	3					
1931.....	0	0	0	0					

¹ Cerebral hemorrhage occurred following the administration of mapharsen.

NUMBER OF PERSONS TREATED FOR SYPHILIS AND OTHER DISEASES

Annually on December 31 each activity reports to the Bureau of Medicine and Surgery, on NMS-Form A, the number of persons in that command who have a history of syphilis, and the number of those in the command who were treated during the year with an arsenical compound, heavy metal, or other antiluetic treatment. A report of the number of persons who were treated during the year with an arsenical compound for a disease other than syphilis is also required. This census does not take into account individuals who left the service during the year.

In the following table, treatment data are listed separately for "active service personnel" and "all others." The term "all others" includes Veterans' Administration patients, dependents of naval

personnel, retired naval personnel, and native populations of insular possessions.

TABLE 6.—*Syphilis and arsenicals, U. S. Navy, 1941*

Item	Persons		
	Navy and Marine Corps	All others	Total
Syphilis census, Dec. 31, 1941.....	¹ 16,608	.....	¹ 16,608
Number of persons treated for syphilis with—			
Arsenicals:			
Bismarsen.....	27	8	35
Mapharsen.....	4,511	444	4,955
Neoarsphenamine.....	834	116	950
Sulfarsphenamine.....	2	6	8
Tryparsamide.....	85	38	123
Total persons treated with arsenicals.....	5,459	612	6,071
Heavy metal compounds:			
Bismuth.....	4,746	534	5,280
Mercury.....	26	2	28
Mixed treatment (specific mixture, etc.).....	3	6	9
Potassium iodide.....	63	17	80
Total persons treated with heavy metal compounds.....	4,838	559	5,397
Number of persons treated for disease other than syphilis with—			
Arsenicals:			
Mapharsen.....	500	8	508
Neoarsphenamine.....	341	1,361	1,702
Fowler's solution.....	23	0	23
Total persons treated with arsenicals.....	864	1,369	2,233
Heavy metal compounds: Bismuth.....	2	0	2

¹ These figures 98.6 percent complete.

In table 6 it will be noted that 864 persons in the Navy and Marine Corps were treated with arsenical compounds during the year 1941 for disease other than syphilis. These diseases were: Angina, Vincent's, 422; acne, 419; gingivitis 12; and other diseases and conditions, 11.

Of the 1,369 persons in the group "all others" treated for diseases other than syphilis, 1,349 were treated for yaws and 20 for other diseases and conditions.

VASOMOTOR PHENOMENA

NEOARSPHENAMINE

(11-1941).—After exposure to infection on July 15, 1938, this patient developed a chancre, a darkfield examination of which was positive for *Treponema pallidum*.

From August 30, 1938, to April 10, 1940, he received 39 injections of neoarsphenamine, a total of 20.7 grams, and from August 30, 1938, to July 24, 1940, he received 62 injections of bismuth salicylate, a total of 8.06 grams. No reaction occurred from this treatment. Kahn blood tests throughout from August 29, 1938, to March 25, 1941, were negative.

The patient was reinfected on May 9, 1941, and 1 month later a diagnosis of syphilis was established by positive darkfield examination and a 4-plus Kahn blood test.

Arsenical treatment for this infection began with a 0.06 gram injection of mapharsen on June 11, 1941, followed by a 0.45 gram injection of neoarsphenamine on June 16, and 0.6 gram injections on June 24, July 1, and July 8.

Immediately after the last injection the patient noted an extreme burning sensation of the skin, followed by nausea and vomiting, diarrheal bowel movements, and profuse sweating. His pulse was rapid and feeble. He was moderately apprehensive. Marked improvement occurred promptly and was progressive following two 0.5 cc. injections of adrenalin. Except for slight residual weakness the patient made a prompt recovery. Antiluetic treatment continued with mapharsen with no further reaction. Recovery in 1 day.

GASTRO-INTESTINAL

NEOARSPHENAMINE

(12-1941).—After exposure to infection on November 14, 1941, this patient developed a primary lesion on shaft of the penis. A darkfield examination was positive for *Treponema pallidum*. A Kuhn blood test was 4-plus.

Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on December 15, 1941, followed by 0.6 gram injections on December 18 and 22.

Six hours after the last injection the patient developed nausea and vomiting of a severe type, pain in the lower abdomen, and a fever of 101° F. The symptoms subsided somewhat during the first night but recurred in intensity 24 hours after the injection. In 36 hours the patient had a fever of 106° F., and continued vomiting and diarrhea, with general malaise. The fever subsided by lysis and reached normal on the eighth day of the reaction. On December 24 (ninth day following the first injection of neoarsphenamine) an erythematous macular eruption appeared on the face, trunk, and extremities. This lasted for 48 hours.

Treatment consisted of 3 intravenous injections of 1,000 cc. of 10 percent glucose in saline. Sedation consisted of sodium amytal, 3 grains, p. r. n., for a total of 5 doses in 48 hours. On December 23 the patient was placed in an oxygen tent where he remained for 3 days. Vomiting controlled. Recovery in 8 days from onset of symptoms.

JARISCH-HERXHEIMER

MAPHARSEN

(13-1941).—After exposure to infection on November 28, 1940, this patient developed a penile lesion, three successive darkfield examinations of which were positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

He was given a 0.03 gram injection of mapharsen, and 5½ hours later he was admitted to the sick list complaining of chills and fever, headache, and aching of the joints. He was in mild shock with a temperature of 102° F., and pulse of 110.

He was given 5 minims of adrenalin, repeated in 30 minutes. One gram of sodium thiosulfate was given intravenously, and antishock therapy with elimination fluids was started. By 9 p. m. the temperature had risen to 103° F., and the pulse was 128. Blood pressure, 126/68; the WBC, 14,800; segs, 77; lymphs, 22; eosins, 1. Previous to the injection the WBC was 7,450. At 10 p. m. the patient felt better but ephedrine sulfate ¾ gr. was continued every 3 hours. By morning the temperature and pulse were normal and there were no complaints. He had undoubtedly experienced a Herxheimer reaction. Recovery in 2 days.

(14-1941).—Several days after exposure to infection on November 8, 1940, this patient developed a rash resembling pityriasis rosea and a slight penile lesion which healed in 2 or 3 days. Routine blood check revealed positive serology.

Arsenical treatment was instituted with a 0.03 gram injection of mapharsen on January 17, 1941, which was followed in 3 hours by a temperature of 102° F., malaise, and a sensation of chilliness. No corresponding rise in pulse and respiration was noted. Four hours later the temperature rose to 104° F. Increased hyperemia of the macular skin lesions accompanied the rise in temperature. No specific treatment given. Recovery in 1 day.

LIVER DAMAGE

NEOARSPHENAMINE

(15-1941).—After exposure to infection on August 25, 1941, this patient developed a penile lesion, a darkfield examination of which was positive on October 15, 1941.

Arsenical treatment began with a 0.45 gram injection of neoarsphenamine on October 14, 1941, followed by 0.6 gram injections on October 21 and 28.

One-half hour after the third injection the patient became nauseated and vomited a number of times. The following day he felt better and ate some food.

Icterus index was 50; Van den Bergh, immediate direct reaction reaching maximal in 30 seconds; bilirubin, 8.9 mg. per 100 cc. of serum; calcium, 10 mg. per 100 cc. of serum; phosphorus, serum inorganic, 2.5 mg. per 100 cc. of serum; Bodansky units, 4.3 mg. per 100 cc. of serum.

No specific treatment was given until November 3, 1941, when the patient was put on salines twice a day, and 7.5 grs. bile salts twice a day, and a fat-free diet consisting of high carbohydrates. He also received 500 cc. of 10 percent glucose in saline.

On November 4, 1941, the patient was jaundiced, but stated that he did not feel badly. On November 11, patient was started on sodium thiosulfate 5 grs. three times a day. Diagnosis was changed to hepatitis, acute, on November 12. Sodium thiosulfate discontinued on November 14. Treatment was received for this condition from November 15, 1941, until January 9, 1942, when the diagnosis was further changed to hepatitis, chronic. Patient invalided from the service on March 19.

(16-1941).—This patient contracted syphilis in January 1940, and alternating courses of neoarsphenamine and bismuth were started on February 14. Following 10 months of treatment (24 injections of neoarsphenamine, a total of 11.25 grams, and 33 injections of bismuth, a total of 4.39 grams) he developed an asymptomatic attack of jaundice. Treatment was continued with bismuth therapy until April 1940 when he was given a course of mapharsen. No ill effects noted.

Numerous icterus indices from April 4, 1940, to August 11, 1941, ranged from 8 to 20. A Van den Bergh test on June 21, 1941, showed an indirect reaction. Occasional abdominal distress and a slight jaundice of the eyes were noted. The nature of the reaction suggests the accumulative action of numerous injections over the period of a year.

Treatment given for the reaction was daily doses of magnesium sulfate orally, and fat-free high caloric diet.

NOTE.—Patient had not fully recovered at the time of submission of report of reaction.

FATAL REACTION

MAPHARSEN

(17-1941).—This patient was given a diagnosis of syphilis because of a positive darkfield examination of a penile chancre. A Kahn blood test was 4-plus on April 26, 1941.

From March 7 to August 26, 1941, he received 13 injections of neoarsphenamine, and from May 8 to July 24 he received 10 injections of bismuth.

The second course of antisyphilitic treatment began with a 1 cc. injection of bismuth subsalicylate intramuscularly on November 3, 1941, and a 0.03 gram injection of mapharsen on November 5. At the time of the injection of mapharsen the patient was being treated with zinc paste for eczema of the hands. Great improvement was noted within 1 week and treatment for syphilis was resumed.

Twenty hours after the injection of mapharsen the patient was seized with excruciating left-sided cephalalgia, so agonizing that he tore the dressings from his eczematous hands, the better to clutch his head. At the same time he complained that he could not see and promptly lapsed into convulsion and coma. The convulsion was marked by generalized tonic and clonic muscular contractions, more marked on the left. Initially, the left pupil was dilated and the right contracted, but later both became equally dilated. Breathing stertorous. There was marked diaphoresis and rubor of the face, and the pulse was rapid but of good quality. Spinal tap produced clear fluid under great pressure. The convulsion lasted about one hour after which the muscular contractions ceased and the patient remained quiet but unconscious. Breathing stertorous. The peripheral reflexes were exaggerated. One hour later the patient suddenly became intensely cyanotic and respiratory failure seemed imminent. Emergency respiratory and cardiac stimulation was of no avail, and the patient died at 9 a. m. on November 6, 1941.

The clinical picture seems to be that of grand-mal seizure, but there are certain aspects of it which seem more like a cerebrovascular accident which though uncommon in young people, might be possible resulting from altered physiology following antiluetic therapy. Epileptiform convulsive seizure 20 hours after mapharsen injection.

The postmortem findings were:

1. Cerebral edema.
2. Hemorrhage of cerebrum, left.
3. Passive visceral congestion, general, acute.
4. Edema of lungs.
5. Eczema of hands.

The cerebral hemorrhage was in a cavity 5 cm. in diameter in cortex and containing about 50 gm. of clotted blood. It is impossible to state whether or not syphilis or treatment (mapharsen) was a definite contributory cause.

REACTIONS OF MINOR IMPORTANCE

MAPHARSEN

(18-1941).—This patient was given a diagnosis of syphilis because of a 4-plus Kahn blood test in 1929.

From June 6 to August 30, 1929, he received 8 injections and from January 8, 1930, to March 19, 1930, 4 injections of salvarsan. From August 29, 1939, to

November 11, 1939, he received 10 injections of mapharsen, and from April 27, 1940, to May 11, 1940, 3 injections. During the period from June 6, 1929, to October 13, 1941, he received 51 injections of bismuth and 18 injections of mercury.

The last course of arsenical treatment began with a 0.03 gram injection of mapharsen on November 5, 1941. A slight reaction was noted following a 0.06 gram injection given on November 12. On November 18, a 0.03 gram injection was given and 30 seconds after the injection, dyspnea, weak fluttering pulse, lowered blood pressure, nausea, and pale, cold clammy skin were noted.

He was placed in a shock bed and given oxygen by inhalation and 1 cc. of coramine by hypodermic injection. Complete recovery in 3 hours.

(19-1941).—After exposure to infection on January 16, 1941, this patient developed a primary lesion and inguinal adenopathy. A darkfield examination of the lesion was positive for *Treponema pallidum*.

Arsenical treatment began with a 0.02 gram injection of mapharsen on February 7, 1941, followed by a 0.03 gram injection on February 10, and 0.06 gram injections on February 12 and 19. He received 3 injections of iodobismutol, and 1 injection of iodobismutol with saligenin as concurrent treatment.

Three hours after the last injection of mapharsen the patient experienced sudden chills followed by fever, prostration, and headache. The temperature ranged from 100° F. to 105° F. for 2 days. No other symptoms were noted.

During the first 2 days of illness the patient was given saline catharsis, forced fluids, and 0.75 gram sodium thiosulfate, intravenously. Complete recovery in 5 days.

(20-1941).—This patient was exposed to infection on February 10, 1941, and 1 month later a Kahn blood test was 4-plus.

From March 11, 1941, to October 22, 1941, he received 20 injections of mapharsen, a total of 1.065 grams, and from May 29, 1941, to August 21, 1941, he received 11 injections of bismuth subsalicylate, a total of 1.43 grams.

One hour after the last injection of mapharsen the patient experienced a shaking chill and a temperature of 103° F. He was put to bed, covered with blankets and hot-water bottles applied. The symptoms subsided and the patient recovered in 1½ hours.

(21-1941).—This patient was exposed to infection on February 15, 1941, and was given a diagnosis of syphilis because of a positive darkfield examination.

Arsenical treatment was instituted with a 0.03-gram injection of mapharsen on February 19, 1941. Two hours after the injection the patient complained of chills, fever, and headache. The temperature was 103° F. Recovery occurred in 6 hours from onset of symptoms.

(22-1941).—After exposure to infection on January 1, 1941, this patient was given a diagnosis of syphilis because of a positive darkfield examination. Antiluetic treatment was instituted with a 0.03 gram injection of mapharsen on March 13, 1941.

Three and one-half hours after the injection the patient developed a temperature of 104° F.; pulse, 116; respiration, 22. Physical examination was essentially negative except for hot, dry skin and high temperature. No other symptoms developed. Temperature was normal the following morning. Recovery in 1 day.

A PRELIMINARY REPORT ON THE TREATMENT AND PROPHYLAXIS OF MALARIA IN SOUTHEAST ASIA¹

By A. H. HAMILTON, Lieutenant Commander, Medical Corps, United States Naval Reserve

In view of the present shortage of quinine and the difficulty with which stocks can be replaced or enlarged, it is of imperative necessity to conserve our existing stocks in every way possible, without, however, jeopardizing the health of our expeditionary forces. This implies that the quinine on hand should be used in the most effective manner and that the greatest care should be taken that no wastage takes place. One of the principal sources of wastage is the use of too large doses or of too protracted courses of treatment.

The use of medicines in malaria is directed toward the attainment of two objectives: First, the cure of the acute attack and of any relapses that may take place; and, second, the "prevention" of persons exposed to the bites of infected mosquitoes developing malaria. It is best to consider the problems in the order presented above, since points developed in discussing the treatment will be used in reference to the problem of "prophylaxis."

TREATMENT

Let us first consider a few of the standard methods employed for the use of quinine in recent years, or as suggested by recognized experts in the past. The following are representative:

The Koch method.—Fifteen gr. of quinine are given each day for a week. This is followed by 3 days quinine-free. Then again 15 gr. a day for 3 days. Then 1 week free from all quinine. Then repeat the 3-day treatment. This plan of week-long rests followed by 3-day periods of treatment is then continued for about 10 weeks to 3 months. The patient is then regarded as cured and dismissed from observation.

The Canal Zone method.—Fifteen gr. of quinine are administered three times a day for a week or until the temperature becomes normal for about a week. This is followed by 10 gr. three times daily for 10 to 12 days.

The "Standard Method" of the Malaria Conference of the National Committee on Malaria of the United States (under date of 1918).—Thirty gr. of quinine daily in 10-grain doses, three times a day for 4 days followed by 10 gr. every night for 8 weeks.

The De Rivas' method.—Fifteen gr. of quinine in a single dose on 3 successive days, or longer, until the febrile attacks entirely disappear. No quinine at all for the rest of the first week. Then

¹ Received for publication September 25, 1942.

follow by the same dose on 3 successive days of each week for 2 months following the initial attack. Then the same 15-gr. dose a day is repeated on 2 consecutive days a week for 1 month, after which the patient is instructed to take 15 gr. once a week for the rest of the season, or for as long as he remains in a malarial district.

A brief analysis of the above four standard courses will show that very large quantities of quinine are required to carry them out. Although there is a certain leeway allowed in each of the three prescriptions other than the "Standard Method," which is cut and dried, approximately the Koch method requires the use of 500 gr. of quinine, the Canal Zone method 660 gr., the Standard Method 680 gr., and the De Rivas' method 540 gr. administered under the control of the physician and an indefinite amount taken afterwards by the patient at the rate of 15 gr. weekly for the rest of his sojourn in the tropics.

These doses are recommended uniformly for men and women, Asiatics and Europeans, regardless of race or state of health. Most authors give separate tables for children, but very few recognize the necessity of cutting the dose down for the slightly built, light-weight Malaysians or other Orientals, or of increasing them for burly European males.

Without further discussion the method of treatment used in recent years by almost all the physicians in the Netherlands Indies with excellent results will be given:

The de Langen method.—Fifteen gr. of quinine hydrochloride (equivalent to 20 gr. of quinine sulfate) are given daily, divided into 2 doses, for 1 week after the onset of the attack. After that all quinine therapy is stopped, but we wait patiently for the appearance of a relapse, which is then treated exactly in the same way as an initial attack.

This method requires the use of a total of only 105 gr. of quinine per patient per attack. Experience shows that when this method of treatment is used it is customary to expect about two or three relapses in the case of tertian, one or two relapses in quartan, and usually no relapses at all in cases of subtertian. It follows, therefore, that to eradicate an attack of tertian completely we use a total of about 420 gr. administered over the course of from a year to 18 months, while for our subtertian patients a single course of 105 gr. usually suffices. There is relatively little quartan in the Netherlands Indies so that that is left out of consideration for the moment. It will be seen, therefore, that by the use of the de Langen method there will be an average saving over the Standard Method of about 260 gr. per case of tertian and of some 550 gr. in a case of subtertian taken in the early stages and treated immediately.

It should be pointed out that the drug used in the de Langen system is quinine hydrochloride. For many years past no physician in the

Indies has used the sulfate or bisulfate. The hydrochloride induces far fewer secondary effects, seems to be far better tolerated by the stomach, and when made into tablets or pills appears not to have the same tendency as the sulfate to harden into a plaster mass which is excreted unchanged in the feces.

The strongest argument for the use of the de Langen system is that experience has shown that by the use of no quantities of quinine, atabrin, or plasmochin is it possible to eradicate relapses entirely. A tertian will usually relapse no matter how or how long the primary attack is treated. Why, then, subject the patient to the real physical and still more real mental discomfort (many of my patients have used the word "torture") of a long course of treatment with a drug (any of the three drugs) when even by that means they are given no certain assurance that they will become free from relapses? During the entire period when more than 10 gr. a day of quinine are being administered the patient should be kept at rest and away from his work. This implies a most protracted period of morbidity in connection with the attack of malaria, which, especially in Army or Navy practice, it is imperative to avoid.

THE SYNTHETICS

Every case of malaria, if taken in time and provided that the general physique of the patient and his state of health when he contracted the disease were not seriously undermined by other conditions, can be cured by the use of quinine. This is a categorical statement, but is based on 20 years of practical experience in a malarial country. The same cannot be said of the synthetics.

Both atabrin and, of course still more so, plasmochin, are and remain dangerous drugs to use. The toxic properties of the various drugs in question have almost always been studied experimentally in healthy persons or healthy animals with healthy organs and very seldom in the sick, "and that is what our malaria patients are first and foremost." It is true that some investigations have been made in artificially infected healthy persons, but those, too, are only of relative value. During an acute attack of malaria the organs would be far more sensitive and therefore the toxicity far greater. Again the state of nutrition of the patient can exert great influence on the untoward action of any drug.¹

¹ So much of this paper is quoted directly or indirectly from the various publications of Dr. C. D. de Langen, formerly for over 20 years Professor of Internal Medicine at the Batavia Medical College and its predecessors in Batavia, that it is felt by the writer to be impractical to give the citation in every instance. General credit is here and now given to Professor de Langen not only for quotations taken from his voluminous writings but also for his years of kindly and patient assistance given so willingly to the writer in studying tropical medicine at first hand.

Long series of comparative studies on malaria patients and others have shown the following facts:

1. There is no liver function test that is sensitive enough to show a slight degree of damage to the liver.
2. As far as can be ascertained, quinine does not damage even a sick liver.
3. Atabrin does not damage a healthy liver, but a diseased or glycogen-poor liver is damaged by it to a greater or less extent.
4. It is important in judging quinine to consider that in the course of years it has won for itself in medical practice a range of indications far beyond that of a mere malaria remedy. It is used frequently in auricular fibrillation. It works admirably in cases of paroxysmal tachycardia and extra systoles; it lengthens the refractory period of the heart and slows down the cyclic excitation wave in the auricle. None of these properties are possessed by atabrin or plasmochin.

In judging or criticising remedies for malaria other than quinine it is not sufficient that we should inquire into their toxicity for various organs; we must also determine whether they possess the same good general properties that are possessed by quinine. It must also be borne in mind when administering such remedies during an acute attack of malaria or other condition that they are being given to a weakened organism laboring under many difficulties.

Atabrin will undoubtedly check the febrile symptoms of acute malaria whether it be of tertian, quartan or tropical (subtertian) variety. In this respect it is probably as good as, but certainly no better than, quinine. Our experience in the Netherlands Indies has been, too, that it is of no greater value than quinine in preventing the appearance of relapses. It will in no way check the many secondary symptoms (heart arrhythmias, general systemic collapse, etc.) often coincidentally present in patients suffering from malaria. Quinine, on the other hand, will do so, provided that it is administered in proper and not excessive doses. Some authors have claimed that atabrin is more effective in treating acute attacks of subtertian malaria. This has emphatically not been our experience, and we have used the drug in thousands of patients, largely under controlled conditions in parallel with cases treated with quinine. Neither quinine nor atabrin will kill the gametes of subtertian parasites circulating in the peripheral blood. These gametes are not responsible for febrile or other symptoms in the patient, but are the means of spreading the disease when sucked up by the biting mosquitoes. Plasmochin, on the other hand, will kill such forms, in which property lies its only value today.

THE PROPHYLAXIS OF MALARIA

There are two kinds of prophylaxis theoretically possible:

1. Casual prophylaxis, in which the body of the subject is rendered so unsuitable a soil for the development of injected parasites that they promptly die off.

2. Clinical prophylaxis, in which the subject actually permits the development of the parasites in his blood but is put into such a state that he never develops clinical symptoms of malaria.

Experiments with healthy volunteers who permitted themselves to be bitten by infected mosquitoes have proved that quinine, even in curative doses has no really causative prophylactic effect. The same is true of the synthetics as long as the dose is held down to clinically permissible, safe amounts. It is true that plasmochin if administered in doses of above 60 mg. (1 gr.) daily will prevent the development of parasites injected subsequently to the commencement of the course, but such doses are impossible in practice because of the toxicity of the drug. Atabrin is also too generally toxic for use in the doses required to engender a true causal prophylaxis.

We are left, therefore, with the problem of considering clinical prophylaxis. This is, in fact, the problem of curing cases of malaria before they develop to the point of showing manifest symptoms of the disease. In places where it is impossible to protect the subjects from being bitten by malaria-infected mosquitoes we must assume that they receive into their blood living plasmodia in forms suitable for development; that the plasmodia develop in the usual way and, if left to their own devices, would, in due course, cause an attack of malaria. It is our duty, then, to remove them or subdue them (inhibit their activity) before they can do this.

The incubation period of malaria is from 6 to 12 days. Our prophylactic "cure" must, therefore, take this into consideration. It is also well known that cases taken early require far less drug to cure them than cases which have been allowed to get a secure grip of the patient.

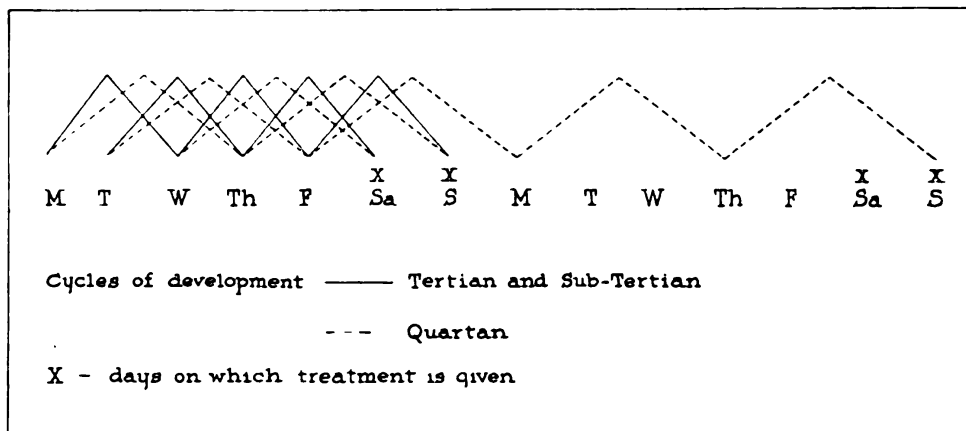
No discussion will be entered into at this time of the various methods that have been suggested from time to time for achieving this end. It is sufficient for our purpose to outline the method that has been used with success in many parts of the East for some time past, notably in the Netherlands Indies, which has the two advantages of being efficient and requiring a minimum use of quinine.

On two consecutive days every week the subject is given at bedtime doses of 10 gr. of quinine hydrochloride. If the body weight is over 150 pounds, this dose may be increased to 15 gr., although as a rule this has not proved essential in practice.

This is the so-called screening method first proposed, it is believed, by Koch, and the chart given below shows how it effectively protects against the inroads of all tertian and subtertian forms of parasites. It is slightly less efficient in the case of the quartan forms, but even there the parasites will be attacked at their most vulnerable moment at intervals no greater than two weeks, which has proved sufficient due to

the longer incubation period of the quartan type of organism. Moreover, in the tropics (at least in the Netherlands Indies) the quartan form of malaria is far less frequently encountered than the other two, so that from a practical point of view the system is highly efficient in such places.

PLATE 46



If used according to these principles, from 20 to 30 gr. of quinine a week (depending upon whether the 10 gr. or the 15 gr. dose is used) are sufficient per man for ensuring as complete a prophylaxis as is possible regardless of the system used. This introduces a saving over the "5-grain per day" method, of 5 gr. per man per week at worst or of 15 gr. if the 10 gr. dose is sufficient, and is, moreover, by actual experiment far more efficient. If the "10-gr. per day" system is used as a basis of contrast, the saving in quinine is much more pronounced and the results are equally satisfactory. Moreover, by the use of the screening method the subject is required to consume so much less quinine that unpleasant secondary reactions are almost entirely avoided and, what may be of still more importance, the subject is not habituated to the effects of quinine, so that if he should subsequently develop an acute attack of malaria he may be treated by normal doses of quinine instead of having to be given larger doses to produce the effect desired. The writer well knows that certain authors deny that quinine produces this effect of habituation; experience in the tropics contradicts this assertion. Malaria developing in persons accustomed to taking small daily doses of quinine is always more difficult to cure than similar cases in persons not so habituated. The bugbear of the tropical physician is the "gin and tonic" addict and the misguided newcomer who has been instructed by friends at home to take a daily dose of quinine "to avoid getting malaria."

A CLINICAL STUDY OF AN OUTBREAK OF SCARLET FEVER

By B. E. GOODRICH, Lieutenant Commander, Medical Corps, United States Naval Reserve, and B. F. HOOPES, Lieutenant, Medical Corps, United States Naval Reserve.

This report is based on a study of 54 cases of scarlet fever observed at the United States Navy Service School, Dearborn, Mich. Fifty-one cases occurred during a single outbreak lasting from January 26 to March 25, 1942. The other three cases were sporadic cases that occurred several months before the outbreak. They are included to present a complete picture of the experience with scarlet fever at this activity. The complications of otitis media, cervical adenitis, sinusitis, and toxic arthritis did not present themselves in any unusual number. The most remarkable fact noted was the great loss of man-days: By patients developing rheumatic fever, by the prolonged hospitalization necessary to obtain negative nose and throat cultures, and by a patient who developed nephritis. Other interesting findings of less importance were the development of transient positive blood Kahn reactions and a high incidence of primary reactions to smallpox vaccine among patients previously successfully vaccinated.

MANAGEMENT

The dispensary at the United States Navy Service School has limited facilities to care for seriously ill patients who require strict isolation. Therefore all patients who developed scarlet fever were sent to the communicable disease service of the Herman Kiefer Hospital in Detroit, Mich. An outbreak of rubella occurred concomitantly with that of scarlet fever. The men with rubella were not removed to the hospital but isolated and cared for in the dispensary or a portion of a barracks, depending upon the number of cases. One man who had rubella later developed scarlet fever. In only one instance was there any difficulty making a differential diagnosis between rubella and scarlet fever. This patient was considered a case of questionable scarlet fever and could only be diagnosed as such when typical desquamation occurred. The Schultz-Charlton reaction was used but proved of little clinical value in this case.

In the hospital the scarlet fever patients were placed on strict isolation in three- to six-bed rooms. This isolation was continued until three negative cultures were obtained from both the nose and throat. The average duration of the period of isolation was 20.2 days, the shortest being 14 days and the longest period being 53

days. Each patient was vaccinated for smallpox soon after he was admitted to isolation care. If the first vaccination did not produce a primary or partial immune reaction another vaccination was done.

TREATMENT

Sulfanilamide was given to the moderately severe cases. Those patients that were only moderately ill received no specific treatment. All cases that were considered severe were given scarlet fever antitoxin in addition to sulfanilamide. A moderate secondary anemia appeared in most patients that were given sulfanilamide, but no other undesirable reaction to this drug was noted. Thirty-five patients were judged to be moderately ill, 15 were moderately severe cases, and 4 were considered severe.

The influence of sulfanilamide, when used during the early stages of scarlet fever, was not conclusive in this small series. The findings, however, agree with the reports of other authors treating larger groups of patients. Wesselhoeft and Smith (24) reporting 200 cases state that sulfanilamide does not reduce the toxicity of scarlet fever and does not reduce the complications. Neither did they detect a reduction in the length of the carrier state when sulfanilamide was given late in the disease. Silferman (17), likewise, found no reduction of the percentage of complications in cases in which sulfanilamide was given. Rascoff and Nussbaum (15) believe that sulfanilamide is not as beneficial in scarlet fever as it is in other streptococcic infections and does not diminish the initial toxicity or the duration of the fever. Fox and Hardgrove (6) believe that it should not be used in the toxic phase of the disease. They recommend its use if complications develop later in the disease. Sako et al (16) found that sulfanilamide reduced the incidence of complications but the rate of recovery from the acute toxic phase of the disease was no more rapid than it was when the drug was not given. They also noted "that patients treated with sulfanilamide did not show the prompt subsidence of toxic symptoms such as have been observed following the administration of serum." These authors conclude that, "early massive intravenous serum therapy to combat toxemia combined with continued large doses of sulfanilamide seems to be the most efficacious treatment for scarlet fever." Bozalis and Barnett (2) found a reduction in both the number of complications and the number of days of fever when patients were given sulfanilamide.

The treatment of our single fatal case presented an extremely difficult problem and the prognosis appeared hopeless almost from the onset. The man was very toxic when he first reported at the sickbay and his entire illness was of only 2-days duration. He was delirious the first night of his illness, and did not respond to sulfanilamide,

scarlet fever antitoxin or blood transfusions. At autopsy a severe sloughing tracheobronchitis was found complicating the scarlet fever. A congenital absence of one kidney may have contributed somewhat to the intensity of his toxic state. Unfortunately no blood chemistry studies were done.

COMPLICATIONS

The variability of the disease from year to year is common knowledge and has been recognized for many years.

Sydenham, in 1664, did not attribute greater importance to the disease than we show nowadays for rubella, and 15 years later, in the sphere of activity of this great observer, in London, the infection appeared with a severity which was only equalled by the bubonic plague. One hundred and fifty years later Bretonneau, a physician of like importance, declared that a scarlet fever patient only died when treated incorrectly; a few years later, when in the presence of an epidemic in which a frightful mortality took place, he was compelled to acknowledge how greatly he had been mistaken (28).

Toomey (22) reports that cervical adenitis is the most common complication of scarlet fever and that arthritis, nephritis, anemia, and cardiac complications are less common. In our cases, slight enlargement of the cervical nodes was present early in the disease in 31 of the 54 cases, but not a single patient suffered from adenitis as a complication. Transient albuminuria, of not longer than 2 days, was observed in only eight instances. In one patient, nephritis developed as a complication. Albumin, granular casts, and red blood cells appeared for the first time on the twenty-eighth day after the onset of the illness. The blood pressure was 165/98. A variable hypertension and decreasing urinary abnormalities persisted for one month at which time he was transferred to the United States Naval Hospital at Great Lakes, Ill.

Otitis media developed in only 2 patients, and in these drainage ceased after 30 and 24 days from the onset of the scarlet fever. Strict isolation, thus preventing cross infection, may have been a factor. Kelsey and Scholes (12) have pointed out that some complications appear to be due to the introduction of another type of streptococcus while other complications are due to an extension of the original infection. They concluded that about one-fourth of the complications in their series was due to cross infection. Age was undoubtedly a factor in the low incidence of otitis media in the group reported upon in this survey. As has been pointed out many times, otitis media is most frequent in children and infrequent during adult life (26) (24) (23) (18) (5) (1). Rare complications such as cholecystitis (19), meningitis (7), hemorrhagic purpura (11), gangrene (8) (4), and periarteritis nodosa (10) did not occur.

Five patients in this series suffered an attack of acute rheumatic fever following their recovery from scarlet fever. This complica-

tion developed after the men returned to active duty and was not confused with the transient acute arthritis which occurs early in convalescence from scarlet fever (24) (9). The average onset of the symptoms of rheumatic fever was 33 days after the diagnosis of scarlet fever had been made. During this outbreak of scarlet fever and the convalescence of these patients, 16 other cases of rheumatic fever were observed at the United States Navy Service School. These occurrences support the etiological association of rheumatic fever with streptococcic infections. D. C. Young (29) of the Herman Kiefer Hospital and C. F. McKhann (14) of the University of Michigan have both observed that rheumatic fever has followed scarlet fever this winter and spring much more frequently than for several years past.

In five instances the initial blood Kahn was reported positive. The blood samples were collected during the first few days of hospitalization. In each case the patient had received a vaccination for smallpox shortly before the blood for the Kahn test was obtained. None of the patients admitted previous venereal disease and no penile scars were observed. In each instance, on repeated examinations, the blood Kahn reaction became negative in from 3 to 5 weeks. Mallory (13) states that false positive reactions may appear temporarily in streptococcic infections; it is, however, probable that the false reactions were due to the smallpox vaccine (20) (21) (3).

All patients were vaccinated the day after they were admitted to the hospital. The material used was smallpox vaccine prepared by the Bureau of Laboratories of the Michigan Department of Health. Twenty-six patients had a primary reaction with the formation of a scar. Twenty-five of these 26 had a recognizable scar from a previous vaccination. All 54 patients had been vaccinated following their induction into the United States Navy and prior to developing scarlet fever. The health records of 12 of the 26 men who had primary reactions were available when this report was prepared. In reviewing these health records these men had been vaccinated between August and December of 1941 at several different induction centers. The reactions reported were immune in 8 cases and accelerated in 4. This experience demonstrates that repeated vaccination for smallpox is necessary although a single scar is present. It also shows the need for careful technic in vaccinating and the use of a potent virus, stored in a suitable fashion and not too old.

SUMMARY

This report is not based on a large series of cases of scarlet fever but interesting problems presented themselves. In only one of the 54 cases was there any difficulty making a diagnosis. Inasmuch as they were all well developed young males the usual complications of

rhinitis, otitis media and cervical adenitis did not occur as frequently as in the usual series of younger patients. A high incidence of active rheumatic fever developed or occurred after the men had returned to duty. Five men had transient positive blood Kahn reactions, which reactions were considered the result of smallpox vaccination. The two complications causing the greatest loss of man days of duty were the rheumatic fever and the prolonged positive nose and throat cultures.

Acknowledgment is made to Dr. D. C. Young of the Herman Kiefer Hospital, Detroit, Mich., for his cooperation in the care of all our scarlet fever patients while they were at that civilian activity.

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A ROUTINE FOR THE DEFINITIVE INVESTIGATION OF GENITAL LESIONS ¹

By MORRIS LEIDER, Lieutenant, Medical Corps, United States Naval Reserve

One of the most urgent military health problems, perhaps next in importance and total volume to the care of actual casualties, is the control of venereal disease among military personnel. So imposing is this problem that the medical authorities of both the Army and the Navy have, for this war especially, trained many venereal disease control officers whose sole duties are concerned with the prevention, diagnosis, and treatment of genito-infectious diseases. Each of these activities involves a complex of intricate and specialized modalities; but therewith the hope of solving the venereal problem seems possible of speedy realization.

The design of this paper is to present a simple, consecutive, standard plan for investigating the ordinary, and particularly the extraordinary, genital lesion until a definitive diagnosis is reached. Nothing is so diagnostically disturbing as the atypical penile or vulvar sore that is, on first examination, darkfield negative, as too many of them are. Furthermore, nothing bothers the medical conscience so much as the possibility of overlooking early, sero-negative syphilis. This stage of that dreadful disease presents the golden opportunity for curative therapy.

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Moore (1) states: "The diagnosis of syphilis is a laboratory, not a clinical, procedure." In this mechanized age, precision testing is the order of the day and the above maxim should consequently be expanded to say that the diagnosis of any and all venereal disease is a laboratory, not a clinical, procedure. Who will claim such infallible diagnostic acumen as to be able to differentiate gonorrheal urethritis from the nonspecific urethritides, the syphilitic or "hard" chancre from the chancroidal or soft sore, lymphopathic inguinal node enlargement from chancroidal inguinal node enlargement, granuloma inguinale from pyoderma, and finally, a host of nonvenereal, dermatologic conditions that happen to be genitally located from the half dozen or so of straight venereal diseases? And who will have the temerity to deny or include mixed or multiple infection on clinical grounds alone? Obviously, no one.

There are fortunately a number of precise laboratory tests which critically, accurately, and in proper sequence performed, will yield a very high incidence of definitive diagnoses in problems of genital lesions. The trouble generally up to now has been that these tests were, until recent years, being critically evaluated and in everyday clinical practice had been applied in a haphazard, incomplete or poorly understood fashion. The result, therefore, has been confusion as often as elucidation. For the sake of completeness, by way of illustration, and with qualifying reservations and comments as to usefulness, a chart of most of the used tests, their approximate technics and the differential diseases for which they are commonly performed, is presented in table 1.

TABLE 1.—A comprehensive chart of laboratory procedures for the investigation of genital lesions

Type of test and approximate technic	Disease for which performed	Reading	Remarks
BACTERIOLOGIC			
1. Darkfield microscopy	1. Syphilis	<i>Treponema pallidum</i> .	Definitive. Simple. Topical or aspirated specimens.
	2. Yaws (Frambesia)	<i>Treponema pertenue</i> .	Do.
2. Smears. Microscopy. Gram and other stains or other processing.	1. Gonorrhea	Gram-neg. intracel. diplococci, the gonococcus.	Definitive; Simple. Topical or expressed specimens.
	2. Chancroid	<i>Hemophilus ducreyi</i> .	Poor. Requires specialized expertness; topical or scraped specimens.
	3. Granuloma inguinale.	Donovan bodies.	Do.
	4. Mycotic dermatoses and pyodermas.	Specific fungi or bacteria.	Definitive, requires some specialized expertness.
	5. Nonspecific urethritides.	Specific organism, e. g., trichomonas.	Good.
	6. Syphilis	<i>Treponema pallidum</i> .	Definitive, but staining of spirochetes is exceedingly difficult and unsatisfactory.
3. Cultures; microscopy, gross appearance; fermentation reaction; stains.	1. Gonorrhea	The gonococcus	Definitive. Requires plain bacteriologic competence.
	2. Chancroid	<i>Hemophilus ducreyi</i> .	Poor. Disputed. Requires more than plain bacteriologic competence
	3. Mycotic dermatoses and pyodermas.	Specific fungi or bacteria.	Definitive. Requires some specialized expertness.

TABLE 1.—A comprehensive chart of laboratory procedures for the investigation of genital lesions—Continued

Type of test and approximate technic	Disease for which performed	Reading	Remarks
ALLERGIC			
1. Intradermal injection of specific antigens.	1. Lymphopathia venerea.	Papule and neg. control.	Excellent. "The Frei test." Requires experienced interpretation. Antigen sources: 1. Infected chick embryo.
	2. Chancroid	Papule	2. Infected human (processed bubo pus).
	3. Syphilis	do	3. Infected mouse brain.
	4. Tuberculosis of genital skin.	do	Excellent. "Ito-Reenstierna test." Requires experienced interpretation. Antigens: 1. Ducrey vaccine. 2. Dmelcos vaccine (foreign). 3. Infected human (processed bubo pus).
SEROLOGIC			
1. Complement fixation	1. Syphilis	Degree of hemolysis.	Poor. "Luetin test." Nonspecific. Poor. Minor evidence unless expertly interpreted.
	2. Gonorrhea	do	Definitive (90-95 percent) "The Wassermann Reaction."
	3. Chancroid	do	Poor. Untrustworthy.
	4. Lymphopathia venerea.	do	Do.
2. Flocculation or precipitation.	1. Syphilis	Flocculation or precipitation	Do.
3. Serum protein determination.	1. Lymphopathia venerea.	Total proteins A/G ratio.	Definitive (90-95 percent). Many techniques, same principles (Kahn, Eagle, Hinton, Kline, etc.)
HISTOLOGIC			
1. Biopsy. Tissue section. Examination by pathologist.	1. Syphilis	Classical pathologic appearance.	Minor evidence. Lower figures and tendency to reversal.
	2. Granuloma inguinale.	do	Excellent. Requires plain pathologic competence. Some dispute classical appearance of syphilitic granulomata.
	3. Chancroid	do	Fair. Requires expertness to recognize Donovan bodies.
	4. Dermatoses	do	Fair. Requires expertness.
BIOLOGIC			
1. Injection or scratch inoculation of infected material into laboratory animal.	1. Syphilis	Chancre formation.	Excellent. Requires expertness.
	2. Herpes simplex (progenitalis).	Rabbitencephalitis.	Definitive. Complicated. Expensive. Requires expertness.
	3. Tuberculosis of genital skin.	Tubercle formation.	Do.
2. Autoinoculation human subject.	1. Chancroid	Soft chancre formation.	Do.
CHEMOTHERAPEUTIC. (RESPONSE TO SPECIFIC MEDICAMENT.)			
1. Arsenicals intravenously.	1. Syphilis	Provocation of pos. blood test. 2. Rapid healing of chancre.	Good. Simple. Harmless.
2. Sulfonamides by mouth.	1. Gonorrhea	Cessation of discharge.	Poor. Dangerous. Confusing. May temporarily suppress manifestations of early syphilis. The "Provocative Wassermann" is a discredited procedure in early syphilis but may have a utility in late syphilis.
	2. Chancroid	Rapid healing of bubo and lesions.	Good. Harmless if definitive diagnosis cannot be made. Better than withholding therapy too long.
	3. Lymphopathia venerea.	Rapid healing of bubo.	Do.
3. Tartar emetic intravenously.	1. Granuloma inguinale.	Rapid healing of lesions.	Do.

Before proceeding to a distillation of the simplest, most feasible and most mandatory tests and their proper order of performance from this inclusive tabulation, it is well to consider, for emphasis, why rapid and definitive diagnosis of venereal diseases is urgently necessary: First, because their therapies are now specific; second, because syphilis is a long-term, insidious scourge that is conquered the better for being attacked forthrightly; third, most of the other venereal diseases have very serious early or late, local or systemic, complications. To quote Moore (1) again, although he refers to syphilis alone and the injunction applies to all the venereal diseases: "There is reason for urgent haste; HOURS COUNT!" In brief, then, for any venereal disease, the possibility of total cure varies directly with the speed of the initiation of treatment.

Given a patient with a genital sore or discharge as the chief, presenting complaint, the order and quality of investigative procedure may be routinely as follows:

1. *History and physical examination.*—The history must be elicited in an honest, detailed, and unashamed way. A knowledge of the average incubation periods of the venereal diseases collated with a trustworthy, precise record of sexual exposures, and the nature of those exposures (e. g., promiscuous, prostitutive) furnishes a presumptive index of venereal disease or a significant item of corroborative evidence. The physical examination involves more than an inspection of the local lesion, which inspection tends to be, but never should be, cursory. By way of example, acute gonorrheal urethritis is rarely examined clinically more than by a deprecating or supercilious glance at the wilted and lachrymose organ and yet every such case should be palpated the length of the urethra for the possibility of intraurethral chancre, which is readily recognizable, when typical, by the characteristically cartilaginous consistency of the *ulcus durum*. The sum of clinical characteristics of a genital lesion, plus possible concomitant general constitutional signs and symptoms, sometimes leads to rapid, correct diagnosis, quickly confirmable by one or two tests. More frequently it will narrow the differential problem to two or three of the venereal diseases and limit the total number of tests required. On enough occasions, however, no sense of diagnostic certainty can be drawn from history and clinical examination, and these are the instances where the subsequent steps are most revealing. Even where clinical certainty exists, what is advised below is profitable to employ for the possibility of mixed or superimposed infection and for academic and statistical completeness. In table 2 is presented a list of diseases important for differential diagnosis, and table 3 is a summary of important clinical differential data.

TABLE 2.—*A list of diseases whose genital lesions may be clinically indistinguishable (modified from Moore)*

- | | |
|-----------------------------------|-------------------------------|
| 1. Syphilis. | 9. Lymphopathia venerea. |
| 2. Gonorrhea. | 10. Balanitis gangrenosa. |
| 3. Chancroid. | 11. Traumatic lesions. |
| 4. Herpes simplex (progenitalis). | 12. Pyogenic lesions. |
| 5. Scabies. | 13. Secondary syphilis. |
| 6. Venereal warts. | 14. Late syphilis (gumma). |
| 7. Carcinoma. | 15. Tuberculosis. |
| 8. Granuloma inguinale. | 16. Miscellaneous dermatoses. |

TABLE 3.—*Important differential data on the signs, symptoms, and course of various venereal diseases*

Disease	Incubation period	Physical characteristics of the primary lesions	Symptomatology locally and constitutionally	Character and response of the regional lymph nodes	Approximate course
Syphilis...	10 days to 6 weeks.	1. Usually present. 2. Site: 90 percent of time around corona. 3. Classically of cartilaginous consistency (ulcus durum). 4. Frequently not classical. 5. Usually solitary; may be multiple ("kissing" chancres, i. e. by intertriginous contact.) 6. Slow development.	1. Chancre is painless. 2. Systemic counterpart may be nothing to grave illness.	1. Enlarged. 2. Discrete. 3. Shotty. 4. Rubbery. 5. Multiple. 6. Not very tender.	Chronic disease but chancre heals spontaneously.
Chancroid.	12 to 48 hours.	1. Always present. 2. Site: On or around genitalia, including scrotum, abdomen, thighs or elsewhere. 3. Soft consistency (ulcus molle). 4. More often multiple; may be solitary or confluent. 5. Rapid development.	1. Ulcers are painful. 2. Usually no systemic illness unless secondarily infected.	1. Enlarged. 2. Solitary bubo. 3. Soft, fluctuant. 4. Hot (acute inflammation). 5. Rapid suppuration. 6. Easy to aspirate (bloody pus). 7. Rapid healing. 8. Very tender.	Chronic in all respects.
Lymphopathia venerea.	2 weeks (1-6 weeks).	1. Rarely seen. 2. A vesicle or abraded area. 3. Evanescent, heals rapidly.	1. Painless. 2. Systemic counterpart may be nothing to grave illness.	1. Enlarged. 2. Multiple. 3. Firm, matted. 4. Overlying skin thickened and purplish (chr. inflam.). 5. Slow suppuration. 6. Hard to aspirate (pure pus). 7. More tender than syphilitic buboes, less than chancroidal. 8. In women rectal involvement by lymphogranulomatous process (result: stricture).	Do.
Granuloma inguinale.	Indefinite.	1. Present. 2. Velvet, beefy red, oozes serosanguineous, chocolate discharge. 3. Large areas, sharp, advancing borders. 4. Site: On and around genitalia, including scrotum and inguinal regions. 5. Islands of healing and cicatrization.	1. Painless. 2. Minor systemic disturbance unless secondarily infected.	1. Not involved per se. 2. Suppurating and cicatrizing lymphangitis (pseudobubo). 3. Not tender.	Do.
Gonorrhea	2-7 days...	1. Characteristics are as for pyogenic infection. 2. Site: Intra-urethral and/or beyond.	1. Urinary pain. 2. Systemic counterpart may be nothing or grave illness.	1. Rare or none, unless complications supervene.	Do.

2. *Darkfield examination*.—This is one laboratory diagnostic procedure that should be performed in every case of a genital lesion, including the urethritis of gonorrhea, no matter what the clinical impression is. To quote Moore (1) a third time: "Any genital sore in male or female is possible primary syphilis until proved to be otherwise." In the case of gonorrhea, meatal, intrameatal and intra-urethral chancre is more common than is generally imagined. Dark-field examination of pus draining sites is nevertheless effectively possible. A solitary darkfield examination, if negative, is only a fraction of the required procedure for a genital lesion. At least three searches on successive days, on occasions more than three, and on other occasions, darkfield examination of serum specimens aspirated from the base of the lesion or the possibly syphilitic inguinal node tumefaction, is a complete testing. The same remarks, with emphasis on utter need for good, competent technic, applies for secondary syphiloderms, mucous membrane lesions and suspicious extragenital sores.

3. *Allergic tests* (2) (3).—The Frei test, or some modification thereof, for lymphopathia venerea and the Ito-Reenstierna test, or some modification thereof, for chancroid should be performed in every instance of venereal disease. A possible exception is classical, proved gonorrhea without bubo. It does not matter if the clinical examination does not suggest either lymphopathia venerea or chancroid, or if their presence should appear relatively unimportant. These tests are simple and inexpensive to perform. The rationale for their routine performance is that often enough a negative clinical impression will be proved wrong and often enough again, a mixed or antecedent infection will be brought to light. These tests, however, require some knowledge and experience in the interpretation of the test findings. Unequivocal positivity in a young person with no previous history or evidence of venereal infection is highly diagnostic. In an older person with a long history of venery, positive readings may mean previous infection or reinfection. In such cases, a discriminating judgment and other evidence are required. Repeated negative tests over a sufficient period of time, say 2 months, can be trusted to rule out lymphopathia venerea and chancroid.

4. *Serologic tests* (4) (5).—A serologic test for syphilis should not only be performed in every case of a genital lesion but indeed for all other illness, local or constitutional, and upon least medical provocation. The reason for this is to maintain what Stokes (6) has termed a "high index of suspicion" for the great imitator that syphilis is. In the case of a venereal problem, a solitary negative serologic test, as in the matter of darkfield examination, is insufficient and should not

terminate the quest. Repeated tests for a period of at least 3 months from the onset of symptoms, with determinations of titer if weak positive reactions are obtained, are essential. Serologic tests for the other venereal diseases are of little or no value.

5. *Other tests.*—From this point on, the definitive laboratory investigation of a venereal problem has no undeviating routine, but requires a higher application of scientific selectivity and ingenuity. The bacteriologic examination of a properly gram-stained smear from a urethral discharge will generally answer the question of gonorrhea conclusively and at once. But frequently enough (30 percent of the time according to Pelouze), such smears are tantalizingly inconclusive. In such predicaments, the culture of the gonococcus contributes greater definition. In more or less specialized and expert hands, smears and cultures from other genital lesions, particularly of nonvenereal, mycotic dermatoses, are very helpful. Biopsy study is frequently feasible and frequently final. Animal inoculation, except under most special circumstances, cannot and need not be attempted. The test of therapy has a limited usefulness and must be employed with caution. It should probably never be employed in even remotely suspected early syphilis.

In brief outline, the recommended routine for the definitive investigation of genital lesions is—

1. Precise history and complete physical examination.
2. Darkfield examination to a positive decision, but not less than three times if negative.
3. Allergic skin tests in all cases except gonorrhea without bubo.
4. Serologic tests for syphilis to a positive decision but not less than for 3 months at close intervals if negative. A good spacing of the tests is weekly for 6 weeks and every 2 weeks for 6 more weeks.
5. Other tests as indicated.

SUMMARY AND CONCLUSIONS

1. The rapid, definitive investigation of genital lesions is of vital importance, and may be complicated.
2. A simple, orderly plan of standard procedure is suggested.
3. By the employment of this routine, it is believed that more and more complete venereal disease diagnoses will be made, and these with greater ease and greater speed.

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STATISTICS

HEALTH OF THE NAVY

The statistics (annual rates per 1,000) appearing in this summary were compiled from data contained in monthly reports of communicable diseases received in the Bureau for the months of April, May, and June, 1942.

ENTIRE NAVY

Year	All diseases	Injuries and poisonings	All causes	Communicable diseases		Venereal diseases
				A	B	
1937	276	36	313	18	98	59
1938	331	50	382	9	79	78
1939	339	48	387	7	85	90
1940	431	51	482	48	118	83
1941	413	47	461	47	118	51
1942	411	48	459	44	137	39

FORCES ASHORE

1937	312	36	347	34	131	27
1938	364	51	415	15	105	45
1939	332	48	380	12	104	41
1940	446	53	498	43	144	52
1941	476	48	524	72	152	36
1942	427	45	472	50	151	25

FORCES AFLOAT

1937	256	37	293	8	78	78
1938	313	50	363	5	64	96
1939	343	47	391	4	75	117
1940	420	50	470	52	99	105
1941	358	46	404	25	89	65
1942	374	54	429	32	108	71

Food poisoning.—Special reports of food poisoning during April, May, and June 1942 were received from four shore stations and two ships. The causes of the outbreaks were listed as ham in two instances, canned milk, human carriers, and hash. The cause of one outbreak was undetermined. The average number of cases admitted per outbreak was 73.

DISEASES CAUSING SURVEY

The following table was prepared from reports of medical surveys in which disabilities or disease causing the survey were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Abscess, alveolar	1	Cerebrospinal syphilis, undifferentiated	7
Abscess, lung	1	Chancroid	1
Abscess, periapical	3	Cholecystitis, chronic	5
Abscess, tibia	1	Chorioretinitis	4
Absence, acquired, teeth	78	Choroiditis	3
Absence, acquired, metatarsal	1	Cicatrix, skin	7
Adhesions, abdominal	10	Cirrhosis liver, hypertrophic	1
Adhesions, finger	1	Colitis, chronic	1
Adhesions, intestinal	2	Colitis, ulcerative	1
Adhesions, peritoneal	1	Color blindness	36
Aerophagia	1	Compression, vertebra	1
Air sickness	3	Constitutional psychopathic inferiority without psychosis	69
Albuminuria	8	Constitutional psychopathic inferiority with psychosis	1
Alcoholism, chronic	16	Constitutional psychopathic personality	1
Allergy	2	Constitutional psychopathic state, criminalism	1
Amblyopia	49	Constitutional psychopathic state, emotional instability	120
Aneurysm, ascending, aorta	1	Constitutional psychopathic state, inadequate personality	103
Angina pectoris	1	Constitutional psychopathic state, paranoid personality	5
Angioneurotic edema	3	Constitutional psychopathic state, pathological liar	2
Ankylosis	7	Constitutional psychopathic state, schizoid personality	1
Aortitis	1	Constitutional psychopathic state, sexual psychopathy	7
Appendicitis, chronic	2	Contracture	2
Arteriosclerosis, cerebral	1	Coronary heart disease, arteriosclerotic	4
Arteriosclerosis, general	1	Coxa vara	1
Arthritis, acute	1	Cryptorchidism	9
Arthritis, chronic	65	Curvature, spine	8
Asthma	49	Cyst, bone	1
Astigmatism, compound hyperopic	3	Cyst, pituitary body	1
Astigmatism, compound, myopic	5	Cyst, teratoma	1
Astigmatism, mixed	2	Cyst, teratoma, inflamed	1
Astigmatism, simple, hyperopic	1	Cystitis, chronic, nonvenereal	2
Ataxia, hereditary	1	Deafness, bilateral	18
Atrophy, muscle	5	Deafness, unilateral	10
Avulsion, tendons	2		
Bronchiectasis	5		
Bronchitis, chronic	1		
Bursitis, chronic	3		
Calculus, parotid gland	1		
Calculus, ureteral	2		
Cardiac arrhythmia, heart block	1		
Cardiac arrhythmia, premature contractions	2		
Cardiac disorder, functional	3		
Cardiospasm	1		
Caries, teeth	8		
Cataract	3		

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Defective physical development	3	Hydronephrosis	6
Deformity, acquired	46	Hyperopia	1
Deformity, congenital	51	Hypertension, arterial	17
Dementia praecox	90	Hyperthyroidism	2
Dementia pugilistica	1	Hypobaropathy	1
Dermatitis, allergic, fuel oil	1	Hypochlorhydria	1
Dermatitis, atropic	1	Hypochondriasis	5
Dermatitis, epidermolysis, bul- bosa	1	Icthyosis	1
Diabetes insipidus	2	Insufficiency, ocular muscle	2
Diabetes mellitus	7	Intracranial injury, old	18
Dislocation, articular cartilage	20	Intraspinal injury, old	2
Dislocation, chronic, recurrent	16	Joint, internal derangement of	22
Dislocation, clavicular joint	3	Keratoconus	1
Dislocation, intervertebral, lumbar	1	Keratoses	2
Duodenitis	7	Leukemia, chronic, myeloge- nous	1
Dyspituitarism	1	Lipodystrophy, progressive	1
Eczema	4	Loose body in joint	4
Effort syndrome	10	Macular degeneration, eye	1
Elephantiasis, nonfilarial	1	Malnutrition	1
Emphysema, pulmonary	2	Malocclusion, teeth	1
Encephalitis, chronic	5	Mastoiditis, chronic	1
Encephalitis, lethargic	2	Masturbation	1
Enteritis, chronic	1	Melanoma	1
Enuresis	64	Ménière's disease	2
Epilepsy	146	Mental deficiency, moron	27
Epilepsy, Jacksonian	1	Metatarsalgia	4
Epiphysitis	3	Migraine	14
Fibroma, feet	1	Myasthenia gravis	1
Fistula, fecal	1	Myocarditis, chronic	3
Flat foot	133	Myopia	13
Foreign body, traumatic	3	Myositis, chronic	38
Fracture, compound, old	1	Myotonia, congenita	2
Fracture, simple	7	Narcolepsy	5
Fungus infection, skin, feet	1	Nephritis, chronic	6
Gastritis, chronic	11	Nephroptosis	1
Gastroenteritis, chronic	1	Neuralgia	3
Gastropptosis	1	Neuritis, multiple	1
Genu valgum	2	Neuritis, optic	1
Glaucoma	1	Neuritis, sciatica	4
Glycosuria	1	Neuritis, ulnar	1
Gonococcus infection, prostate	1	Neurocirculatory asthenia	1
Gout, acute	1	Neuroma, median nerve	2
Hammertoe	2	Neuroma, skin	1
Headache	16	Neurosis, cardiac	2
Heart disease, congenital	9	Neurosis, gastric	2
Hemiplegia, old	1	Neurosis, intestinal	18
Hemorrhage, gastric	1	Neurosis, traumatic	1
Hemorrhoids	1	Neurosis, stomach	1
Hernia, inguinal, direct	1	Night blindness	1
Hernia, inguinal, indirect	26	Nostalgia	9
Hernia, recurrent after oper- ation	5	Nystagmus	1
Hernia, femoral	1	Obesity	3
Hernia, traumatic, interverte- bral	2	Obstruction, intestinal, from internal causes	2
Hernia, muscle	3	Opacity, cornea	3
Hernia, ventral	1	Osgood-Schlatter disease	3
Hernia, umbilical	1	Osteitis fibrosa cystica	1
Hydrocele	1	Osteoarthropathy, hypertrophic	2
Hydrocele, tunica vaginalis	2	Osteochondritis deformans	4
		Osteochondritis dissecans	4
		Osteochondroma	3

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Osteoma	2	Rupture, nontraumatic	1
Osteomyelitis, chronic	11	Rupture, traumatic	3
Otitis media, chronic	84	Sclerosis, combined	1
Otosclerosis	1	Sclerosis, disseminated	2
Ozena	1	Seasickness	7
Pansinusitis	1	Sexual perversion	8
Papilloma, bladder	1	Simple adult maladjustment	1
Paradentosis	14	Sinusitis, ethmoidal	1
Paralysis agitans	2	Sinusitis, frontal	1
Paralysis, ocular muscle	3	Sinusitis, maxillary	2
Paralysis, partial, spinal cord	1	Somnambulism	12
Paralysis, ulnar nerve	1	Sprain	18
Paranoia	1	Spondylolisthesis	6
Paranoid state	2	Spondylitis	5
Pemphigus	1	Strabismus	11
Perforated nasal septum	2	Strain, muscle	2
Periostitis, chronic	1	Stuttering	2
Pes cavus	12	Syncope	8
Phimosis	1	Synechia	2
Phlebitis	4	Synovitis, chronic	3
Pleurisy, fibrinous, chronic	11	Synovitis, traumatic	2
Pleurisy, serofibrinous	1	Syphilis	32
Pneumoconiosis	1	Syphilis, seropositive only	7
Pneumonitis, chronic, nontuberculous	4	Tabes dorsalis	1
Poliomyelitis, anterior, chronic	3	Tachycardia	6
Polypus, nasal	2	Talipes	7
Prostatitis, chronic, nonvenereal	3	Thrombo-angiitis obliterans	1
Psychoneurosis, anxiety neurosis	28	Thrombosis, coronary artery	2
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NOTES ON OUR RESERVE CONTRIBUTORS

Bakst, Henry J., Lieutenant Commander (MC), USNR (*The Use of Local Anesthesia in The Treatment of Contusions and Sprains*, p. 107). Ph. B., Brown University, 1927. Teaching fellow in embryology Brown University, 1927. M. D., Harvard Medical School, 1931. Teaching fellow in histology Harvard Medical School, 1928-31; resident in medicine Boston City Hospital, 1932-34; executive assistant Boston City Hospital, 1934; assistant in medicine Boston University School of Medicine, 1933-35; instructor in medicine, 1935-41. Hospital staffs: Boston City Hospital, Massachusetts Memorial Hospital. Certified by American Board of Internal Medicine, 1941.

Bueermann, W. H., Lieutenant Commander (MC), USNR (*The Latent Period and Delayed Hemorrhage Following Traumatic Rupture of the Spleen*, p. 73). B. S., McMinville College, 1917; M. D., Columbia University, 1921. Fellowship in surgery Mayo Clinic, 1922-25; assistantship in surgery Mayo Clinic, 1925-27. Ph. D., University of Minnesota, 1927. Clinical associate in surgery University of Oregon Medical School, 1929-; consulting surgeon Southern Pacific Railroad, 1933-40; attending surgeon Doernbecher Memorial Hospital for Children, 1929-42; attending surgeon Emanuel Hospital, 1920-42; president, medical staff, Coffey Memorial Hospital, 1939. Fellow American Medical Association; Portland Academy of Medicine; fellow American College of Surgeons; Oregon State Medical Society; Portland City and County Medical Society (vice president, 1939-41); certificate holder American Board of Surgery. Surgical practice in Portland, Oregon, 1927-42.

Claiborne, Elmer M., Lieutenant Commander (MC), USNR (*Coarctation of the Aorta Discorered Through Photofluoroscopic Findings*, p. 172.) M. D. Columbia University, 1923. Resident, New York Skin and Cancer Hospital, 1925-26; resident radiologist New York Hospital, 1931-32; assistant radiologist New York Hospital, 1932-35; roentgenologist French Hospital, New York City, 1935-42; instructor, roentgenology, New York University, 1936-42. Member American Board of Radiology, Radiological Society in North America, College Radiology, New York Roentgen Society.

Cone, Thomas E., Jr., Lieutenant (MC), USNR (*Determination of TNT—2, 4, 6-Trinitrotoluene—in Air*, p. 219). B. A., Columbia University, 1936; M. D., College of Physicians and Surgeons, New York City, 1939. Intern Lenox Hill Hospital, New York City, 1939-41.

Cuttle, Tracy D., Lieutenant (MC), USNR (*A Method for Evaluating the Muscle Balance in So-Called "Flat Foot"*, p. 216). A. B., University of California, 1931; M. D., University of Pennsylvania, 1935. Exchange fellow, medicine, St. Bartholomew's Hospital, London, 1937-38; research fellow, medicine, Pennsylvania Hospital, 1938-40. Assistant demonstrator, medicine, Jefferson Medical College, 1938-39; instructor, medicine, Jefferson Medical College, 1939-40, demonstrator, medicine, 1940-41; assistant physician, chief of out-patient department, assistant cardiac clinic, Pennsylvania Hospital; assistant, diabetic clinic, Jefferson Hospital. Fellow American Medical Association; member Philadelphia County Medical Society; Jefferson Society for Clinical Investigation.

Dailey, J. Emerson, Lieutenant (MC), USNR (*Foreign Body in the Esophagus*, p. 167). B. S., St. Bonaventure's College, 1926; M. D., University of Buffalo, 1929. Practiced general surgery, Olean, New York, 1932-36; resident thoracic surgeon Sea View Hospital, Staten Island, New York, 1936-37; practiced thoracic surgery as a specialty in Houston, Texas, 1937-41. Society affiliations: Texas State Medical Society, Harris County Medical Society, Texas Tuberculosis Association (member of Board of Directors), National Tuberculosis Association, American Trudeau Society (member of the Committee on Educational Literature since 1939; past chairman of the Committee); fellow American College of Chest Physicians; Clinical Society of Sea View Hospital, Southern Medical Association, Southern Tuberculosis Conference, Houston Academy of Medicine.

Downs, T. McKean, Commander (MC), USNR (*The Suturing of Clean Wounds*, p. 68; *A Reaction of Dried Pooled Human Plasma*, p. 189). M. D., University of Pennsylvania Medical School, 1921. Private practice, Philadelphia, 1925-41; assistant surgeon Pennsylvania Hospital; surgeon Bryn Mawr Hospital and Germantown Hospital; instructor operative surgery, Graduate School of Medicine, University of Pennsylvania. Philadelphia County Medical Society; Delaware County Medical Society; Pennsylvania State Medical Society; American Medical Association; Academy of Surgery, Philadelphia; College of Physicians, Philadelphia.

Ecklund, A. M., Lieutenant Commander (MC), USNR (*The Pathology of Immersion Blast Injuries*, p. 19). M. D., St. Louis College of Physicians and Surgeons, 1922. Private practice, St. Louis, Mo., 1923-28; director pathological laboratory of Kauai Medical Society; pathologist Mahelona Hospital, Kauai Plantation Hospitals, and Wilcox Hospital, Kauai; bacteriologist Board of Health, Kauai. St. Louis Medical Society; American Medical Association; American Society Tropic Medicine; American Public Health Association.

Fulcher, O. Hugh, Lieutenant Commander (MC), USNR (*Progressive Facial Hemiatrophy*, p. 192). B. S., William and Mary College, 1922; M. D., University of Virginia, 1926; M. S., surgery, Mayo Clinic, 1931. Internship University of Virginia Hospital, Mason Hospital, Seattle. Fellow Mayo Foundation, 1928-33; fellow American College of Surgeons, 1934. Associate professor, clinical surgery, Georgetown University, 1937-.

Gates, Russell, Lieutenant Commander (MC), USNR (*Roentgen Findings on Immersion Blast Injuries*, p. 12). B. S., University of Minnesota, 1921, M. B., 1922, M. D., 1923. Teaching fellow in radiology, University of Minnesota, 1923-24. Roentgenologist Glen Lake Sanatorium, Oak Terrace, Minnesota; Lymanhurst Preventorium, Northwestern and New Asbury Hospitals, Minneapolis, Minnesota, 1924-28; head of Department of Radiology, Northwest Clinic, Minot, North Dakota, 1928-35; roentgenologist Santa Barbara Cottage and Santa Barbara General Hospitals, 1935-42. Member American Medical Association, American Roentgen Ray Society, Radiological Society of North America, Pacific Roentgen Club; diploma's American Board of Radiology.

Glenn, Wadley R., Lieutenant Commander (MC), USNR (*Tinea Versicolor*, p. 205). B. S., Georgia School of Technology, 1929; M. D., Emory University Medical School, 1933. Grady Hospital, 1933-37. Practiced general surgery, Atlanta, 1937-41. Fellow American College of Surgeons; member American Medical Association, Fulton County Medical Society; Medical Association of Georgia.

Goodrich, B. E., Lieutenant Commander (MC), USNR (*A Clinical Study of an Outbreak of Scarlet Fever*, p. 273). B. S. and M. D., State University of Iowa, 1926. Resident in medicine, Henry Ford Hospital, Detroit, 1928-30; associate physician, Cardio-Respiratory Division, Henry Ford Hospital, 1930-42. Certified American Board of Internal Medicine; member American Medical Association and Central Society for Clinical Research; fellow American College of Physicians and American College of Chest Physicians.

Gowan, L. R., Lieutenant Commander (MC), USNR (*Psychiatric Aspects of Military Disabilities*, p. 129). A. B., Park College, 1918; M. D., University of Minnesota Medical School, 1922. Teaching fellow, University of Minnesota School of Medicine, Dept. of Nervous and Mental Diseases, 1923-25. M. S. in nervous and mental diseases, University of Minnesota, 1925. Private practice of neurology and psychiatry, Duluth, Minnesota, 1925-41. Chief of Department of Nervous and Mental Diseases, St. Marys Hospital, Duluth, Minnesota; attending neuropsychiatrist and chief of Out Patient Dept., Miller Memorial Hospital, Duluth; consulting psychiatrist Duluth Mental Hygiene Clinic. Member American Medical Association, American Psychiatric Association, Central Neuro-psychiatric Association; Minnesota Society of Neurology and Psychiatry; diplomate American Board of Psychiatry and Neurology.

Gunther, Lewis, Lieutenant Commander (MC), USNR (*Sulfathiazole Fever*, p. 199). Junior Certificate, University of California at Los Angeles, 1921; M. D., Yale University School of Medicine, 1926. Attending physician Los Angeles County Hospital, 1929-37; associate senior physician Cedars of Lebanon Hospital, Los Angeles, 1942; consulting supervisor Cedars of Lebanon Medical Clinic; co-chief, cardiology, Mount Sinai Hospital and Clinic, Los Angeles, 1939; consulting physician University of California at Los Angeles, and attending physician at St. John's Hospital, Santa Monica, California, 1942; assistant clinical professor of medicine College of Medical Evangelists, Los Angeles, since 1939. Certified by the American Board of Internal Medicine, 1939. Member American Medical Association; American Heart Association.

Hailey, Hugh E., Lieutenant (MC), USNR (*Tinea Versicolor*, p. 205). B. A., University of Georgia, 1930; M. D., Emory University School of Medicine, 1935; postgraduate work in dermatology, Columbia University, 1936-37. Assistant, dermatology, Emory University School of Medicine; diplomate American Board of Dermatology & Syphilology; member American Medical Association, Medical Association of Georgia, Fulton County Medical Society, American Academy of Dermatology, Southeastern Dermatological Society.

Hamilton, A. H., Lieutenant Commander (MC), USNR (*A Preliminary Report on the Treatment and Prophylaxis of Malaria in Southeast Asia*, p. 267). M. D., University of Pennsylvania Medical School, 1919. District surgeon, North Borneo; medical director, Davao Mission Hospital, Davao, Philippine Islands; International Health Board (Rockefeller Foundation), later carrying on the same work under the Public Health Service of the Netherlands Indies. Five years' work in Batavia Central Civil Hospital. Translated into English, Dr. C. D. de Langen's "Clinical Text-book of Tropical Medicine."

Hamlin, H., Lieutenant (MC), USNR (*Neurological Observations on Immersion Blast Injuries*, p. 26). M. D., Yale, 1936. Internship Bellevue Hospital, New York City, 1936-38; assistant, neuropathology, Yale University, 1938-39; resident, neurology, Bellevue Hospital, 1939-40; assistant, neurosurgery, Boston City Hospital; Massachusetts General Hospital, 1940-41; resident, neurosur-

gery, Children's Hospital, Boston, 1941-42. Fellow American Museum Natural History; American Society of Physical Anthropologists.

Harner, C. E., Commander (MC), USNR (*Extra-Urethral Penile Gonococcal Infection*, p. 197). M. D., University of Colorado, 1920. Visiting surgeon Colorado General Hospital, Denver General Hospital, 1920-25; assistant in ophthalmology, University of Colorado Medical School, 1923-25. Fellow American Medical Association; fellow American College of Surgeons; fellow American Academy of Ophthalmology and Otolaryngology; American Board of Ophthalmology; American Board of Otolaryngology; California Medical Association; Los Angeles County Medical Association; Los Angeles Society of Otolaryngology and Ophthalmology; Pacific Coast Society of Otolaryngology and Ophthalmology.

Hicks, R. A., Lieutenant Commander (MC), USNR (*An Improved Method for the Administration of Human Plasma and Whole Blood*, p. 213). B. S., University of Michigan, 1926; M. D., 1930. Teaching assistant University of Michigan, 1925-29; Intern Institute of Pathology, Western Pennsylvania Hospital, Pittsburgh, 1929-31; pathologist St. Mary's Hospital, Southern Methodist Hospital, Wyatt Clinic, Tucson, Ariz., 1931-37. Arizona State Medical Society; American Medical Association; American Association for the Advancement of Science, American Rheumatism Society; Society of American Bacteriologists.

Hoopes, B. F., Lieutenant (MC), USNR (*A Clinical Study of an Outbreak of Scarlet Fever*, p. 273). B. S., Scheffield School of Science (Yale), 1933; M. D., Yale, 1937. Clinical assistant Cornell Medical School, 1937-39; assistant resident Henry Ford Hospital, 1939-41; resident surgeon Henry Ford Hospital, 1941-42; M. S. (Surgery), University of Michigan, 1941. Wayne County Medical Society; Michigan State Medical Society; American Medical Association; American Association for the Advancement of Science.

Jameson, Edwin M., Lieutenant Commander (MC), USNR (*Diaphragmatic Hernia*, p. 183). B. S., Pennsylvania State College, 1924; M. D., University of Pennsylvania, 1927. Private practice Saranac Lake, N. Y., 1929-40; attending surgeon Saranac Lake General Hospital; consulting surgeon Reception Hospital, Trudeau Sanatorium, Will Roger's Memorial Hospital. New York State Medical Society; American Medical Association; American College of Surgeons.

Kelly, Robert E., Lieutenant (MC), USNR (*Extra-urethral Penile Gonococcal Infection*, p. 197). B. S. M., Creighton University, 1933; M. D., Creighton University, 1935. Resident, pathology, Kings County Hospital, Brooklyn, New York, 1936-37; general practice Grand Rapids, Michigan, 1937-41; junior surgical staff Butterworth Hospital, 1937; visiting staff St. Mary's Hospital, Blodgett Hospital, Evangeline Hospital, Grand Rapids, Mich. Member Kent County Medical Society; Aero Medical Association; National Aeronautics Association; Michigan State Medical Society; American Medical Association.

Krueger, Albert P., Commander (MC), USNR (*The Use of the Red Blood Cell Agglutination Test in the Study of Influenza*, p. 114). A. B., Stanford, 1925; M.D., 1928. Assistant bacteriology and experimental pathology Stanford, 1927-28, acting instructor, 1928-29, instructor and assistant professor, 1929; associate, general physiology, Rockefeller Institute, 1929-31; associate professor, bacteriology, University of California, 1931-, consultant communicable diseases, student health service, and lecturer medicine, medical school, 1932-. Assistant visiting physician University of California Hospital, 1931-, consultant bacteriology, 1932-; grant, cmt. scientific research, American Medical

Association, 1938. A. A., Society of American Bacteriologists; Society for Experimental Biology; Society for Experimental Pathology; American Association of Immunologists.

Leider, Morris, Lieutenant (MC), USNR (*A Routine for the Definitive Investigation of Genital Lesions*, p. 278). A. B., University of Pennsylvania; M. D., Columbia University, 1933. Assistant, dermatology and syphilis, New York Skin and Cancer Hospital, 1935-41. Member Kings County Medical Society; American Medical Association.

Lewinski, Robert John, Lieutenant (HC), USNR (*Psychological Services with the Medical Department*, p. 137). Ph. B., University of Toledo, 1934; M. A., State University of Iowa, 1936; Ph. D., 1939. Director and chief psychologist Child Study Institute, Toledo; lecturer, psychology. University of Toledo. Member American Psychological Association; Midwestern Psychological Association; Ohio Academy of Science.

McCormick, George W., Lieutenant Commander (MC), USNR (*The Use of Local Anesthesia in the Treatment of Contusions and Sprains*, p. 107.) A. B., University of Pennsylvania, 1930; M. D. C. M., McGill University, 1935. Assistant pediatricist St. Vincent's Hospital, Staten Island, New York; assistant pediatricist Richmond Memorial Hospital, Staten Island; associate physician Richmond Boro Contagious Hospital, Staten Island. Member Cardiac Committee of Staten Island; secretary Richmond County Medical Society, 1939-41.

Master, Arthur M., Commander (MC), USNR (*Borderline Hypertension and the Navy During the Emergency*, p. 52). B. S., College of the City of New York, 1916; M. D., Cornell, 1921. Cornell traveling fellow University Col. Hospital Medical School, London, 1924-25; adj. physician Mt. Sinai Hospital, New York, 1928-34, cardiographer, 1933, associate in medicine, 1934-41; electrocardiographer, clinic, medical college, Cornell, 1927-32. Cardiac consultant U. S. Veterans' Hospital No. 81, 1927-28; cardiologist Joint Disease Hospital, 1927-30; chief cardiac clinic, New York Hospital, 1928, assistant cardiographer, 1927-32, physician, out-patient department, 1933-41; assistant professor, clinical medicine, Columbia University, 1939-41. Member A. A.; American Medical Association; American College of Physicians; Society for Experimental Biology; Harvey Society; New York Academy of Medicine; New York Path. Society. Author, *Electrocardiogram and X-ray Configuration of Heart*, 2nd edition, 1942.

Mazet, Robert, Jr., Lieutenant Commander (MC), USNR (*An Ambulatory Traction Device for the Treatment of Fractures of the Cervical Spine*, p. 207). Ph. B., Brown University, 1924; M. D., Columbia University, 1928. Private practice New York City, 1931-40; attending surgeon Meadowbrook Hospital; assistant surgeon O.P.D., Ruptured and Crippled Hospital; junior surgeon Nassau Hospital. American Medical Association; American Board of Orthopedic Surgery; American Academy of Orthopedic Surgery; Nassau County Medical Society; Nassau Surgical Society.

Oliver, Wrenshall A., Lieutenant (MC), USNR (*The Recognition of Early Parkinsonism*, p. 111). A. B., University of California, 1927; M. D., 1931. Private practice, San Francisco, 1931-. Licensed by American Board of Neurology and Psychiatry, 1939. Assistant visiting neurologist, San Francisco City and County Hospital, 8 years; clinical instructor in neurology and psychiatry, Stanford University Medical School, for 5 years; acting medical director, Alexander Sanitarium, Belmont. Member San Francisco County Medical

Society, American Medical Association; American Psychiatric Society, Northern California Neuropsychiatric Society.

Palma, Joseph, Lieutenant Commander (MC), USNR (*Immersion Blast Injuries*, p. 3). M. D., University of Michigan Medical School, 1920. St. Joseph's Mercy Hospital, Ann Arbor, Mich., 1920-24; private practice Honolulu, 1924-40; attending pediatrician Queen's Hospital, Children's Hospital, and Kaplani Maternity and Gynecological Hospital; chief pediatrics department, Olinic, Honolulu, Hawaii, 1924-41. Honolulu County Medical Society; American Medical Association; Territorial Medical Society of Hawaii; fellow, American Academy of Pediatrics. Author, A Guide to Mothers in Hawaii.

Ruddock, John C., Commander (MC), USNR (*Anomalous Origin of Left Coronary Artery*, p. 175.) B. S., University of California, 1913; M. S., 1914; M. D., 1916. Private practice, medicine, 1920-42; associate clinical professor, medicine, University of Southern California, 1930-42. Fellow American College of Physicians, 1934; president California Heart Association, 1936; certified specialist by American Board of Internal Medicine as internist and cardiologist, 1938. Developed technic and instrument for peritoneoscopy in 1934. Awarded the "Distinguished Achievement Award" in 1938. President Board of Health Commissioners of the City of Los Angeles, Calif., 1939-42; president Los Angeles Medical Association, 1941-42; chief of staff St. Vincent's Hospital, Los Angeles, 1938; consultant Santa Fe Railway, 1936-42; member American Medical Association; American Heart Association; Los Angeles Academy of Medicine; Symposium Society; California Medical Association; Los Angeles Medical Association.

Short, James J., Lieutenant Commander (MC), USNR (*Coarctation of the Aorta Discovered Through Photofluoroscopic Findings*, p. 172). M. D., University of Buffalo, 1918. Instructor, chemistry, New York Post-Graduate Medical School of Columbia University, 1918-20; medicine, College of Physicians and Surgeons, Columbia, 1921-23; instructor and associate New York Post-Graduate Medical School, Columbia, 1923-30; associate clinical professor of medicine, 1931-. Chief of medical clinic and associate attending physician New York Post-Graduate Hospital; research director and associate director Life Extension Examiners, New York; director medical service, Department of Correction Hospitals, New York; attending physician Welfare Hospital for Chronic Diseases, New York. Member New York County and New York State Medical Societies; American Medical Association; fellow American College of Physicians.

Stein, Calvert, Lieutenant (MC), USNR (*Neuropsychiatry in the United States Navy*, p. 142). M. D., Tufts Medical School, 1928; LL.B., Northeastern University, 1938. Certified by American Board of Psychiatry and Neurology, 1936 and 1937. Diplomate National Board Medical Examiners, 1929. Senior Physician Monson State Hospital, 1931-38; director Springfield Child Guidance Clinic, 1931-38; neurologist Springfield Hospital, 1936-; private practice, neuropsychiatry, Springfield, Mass., 1933-41. Fellow American Psychiatric Association.

Stout, Gurn, Lieutenant Commander (MC), USNR (*Postoperative Ilcus*, p. 56). B. S., University of Nebraska, 1924; M. D., 1926. Private practice Los Angeles, 1927-41. Los Angeles County Medical Association; California Medical Association, Hollywood Academy of Medicine.

Uldall, J. J., Lieutenant (MC), USNR (*Immersion Blast Injuries*, p. 3). B. S., Creighton University School of Medicine, 1936; M. D., 1938. Assistant, roent-

genology, University of California Hospital, San Francisco, 1939-40; roentgenologist University of California Hospital.

Walker, J. E., Lieutenant Commander (MC), USNR (*Sulfathiazole Fever*, p. 199). M. D., University of California Medical School, 1925. Staff member Long Beach Community Hospital, St. Mary's Hospital, and Seaside Hospital, Long Beach, California; chief of staff Seaside Hospital, 1933-35; chairman of Medical Section, 1935-37. Fellow American Medical Association; member local, county and State Medical Societies; California Heart Association; diplomate American Board of Internal Medicine, 1938; fellow American College of Physicians.

Wheeler, D. W., Lieutenant Commander (MC), USNR (*Shock; Its Nature and Therapy*, p. 93). S. B., Knox, 1915; M. D., University of Chicago (Rush), 1921. Assistant, pathology, Rush, 1917-20; resident surgeon Peter Bent Brigham Hospital, 1921-22; assistant physician Trudeau Sanatorium, 1923-24; assistant medical director Nopeming Sanatorium, 1924-25; attending physician St. Louis and St. Mary's Hospital, Duluth, 1924-41. American Medical Association; Minnesota State Medical Association; Minnesota Society of Internal Medicine; licentiate American Board of Internal Medicine; fellow American College of Physicians; fellow American College of Chest Physicians.

White, James C., Lieutenant Commander (MC), USNR (*Painful Edema of the Extremities in Shipwrecked Mariners*, p. 32). A. B., Harvard College, 1917; M. D., Harvard Medical School, 1923; pathology, Johns Hopkins Hospital, 1923-24. Surgical internship and residency Massachusetts General Hospital, Boston, 1924-27. Moseley travelling fellow, working under Prof. Leriche at Strasbourg and Prof. Hovelacque at Paris, 1927-28. Associate in surgery Massachusetts General Hospital, 1929-34; assistant visiting surgeon, 1935-39; visiting neurosurgeon, 1940-41; chief of neurosurgical service, 1941-. Alumni assistant in surgery Harvard Medical School, 1926-27; assistant in surgery, 1928-29; instructor, surgery, 1930-31; faculty instructor and tutor, surgery, 1932-33; assistant professor and tutor, surgery, 1934-.



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THE MISSION OF THE MEDICAL CORPS OF THE NAVY

**TO KEEP AS MANY MEN AT AS MANY GUNS
AS MANY DAYS AS POSSIBLE**

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TRUMAN H. NEWBERRY,
Acting Secretary.

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II

PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

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ROSS T MCINTIRE,
Surgeon General, United States Navy.

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The editor regrets to have to say that reprints of articles can no longer be supplied by the Government Printing Office.

ROBERT C. RANDELL, *Editor,*
Commander, Medical Corps,
United States Naval Reserve.
STEPHEN A. ZIEMAN, *Assistant Editor,*
Lieutenant Commander, Medical Corps,
United States Naval Reserve.

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SPECIAL ARTICLES

OBSERVATIONS ON THE TREATMENT OF BATTLE WOUNDS ABOARD A HOSPITAL SHIP¹

By L. KRAEER FERGUSON, Commander, Medical Corps, United States Naval Reserve;
R. B. BROWN, Lieutenant Commander, Medical Corps, United States Naval
Reserve; J. T. NICHOLSON, Lieutenant Commander, Medical Corps, United
States Naval Reserve; and H. E. STEDMAN, Lieutenant Commander, Medical
Corps, United States Naval Reserve

The U. S. S. ——— has had the valuable experience of observing and treating well over 4,000 casualties of the Navy, Marines, and Army, which have arisen since the offensive thrust began early in August 1942. The patients have been largely surgical, and we have received them from ships and various forward areas. A fair percentage of the patients reached the ship as early as 12 hours after they had been wounded; a large number during the first 2 to 4 days after injury, many of these with their original battle dressings in place. Most were received within 5 to 14 days after they had been injured, and a few as long as a month after injury. All these had received treatment elsewhere.

Most of the patients were received in excellent condition. This largely accounts for the fact that we have had only 7 deaths in 4,039 patients, only 6 of which deaths were battle casualties. The treatment given before we received the patients varied a great deal depending upon the facilities. In some cases, when patients were received from ships where medical spaces were destroyed or when there were numbers of wounded to be cared for by a limited personnel, little more than first aid had been possible. In other instances, excellent, definitive treatment had been given and we simply carried on the treatment. About two-thirds of our patients came from shore stations where adequate hospital care was available and expert medical attention was at hand.

We were able, therefore, to observe these casualties at all stages of their clinical course, and after various methods of treatment had been tried. So in spite of the fact that the patients were aboard the U. S. S.

¹ Received for publication December 17, 1942.

—— a relatively short time, our observations and experiences have led us to some very definite conclusions with regard to the care and treatment of the wounded in this area.

Naval casualties which made up approximately one-third of our patients had some distinctive features. The most common types were multiple shell-fragment wounds and compound fractures. In a large percentage of cases, the fragments seemed to travel in an upward direction. Fractures of the os calcis from under-deck explosions were not uncommon. The burns we received came almost entirely from ships, and there was a fair smattering of such unusual injuries as immersion blast, and shark bites. These casualties were marked by an unusually high number of multiple injury cases, fractures, burns, and foreign bodies occurring all in one patient.

The Marine casualties included a large number of fragment wounds from shells and grenades, often multiple; but there were many more single injuries from bullet or bayonet. In this group too, were a large number of fractures of all types, almost all compound.

WOUNDS AND WOUND TREATMENT

The wounds varied greatly in size, from small puncture wounds to some as large at 12 by 8 inches in extent. Many of them were superficial wounds made by flying, tangential fragments causing marked loss of skin surface. Others were large, deep wounds from which cut ends of muscle and often bone fragments protruded.

Most of the early wounds were received with one of the sulfonamide drugs, sulfanilamide or sulfathiazole, caked in the wound and covered by a dressing. They were remarkable in that there was an absence of any marked inflammatory reaction in them or about them. They were not sterile but there was no spreading infection except in a very few cases. Necrosis and some sloughing of devitalized tissue occurred, but without much pain or systemic reaction. It was not unusual for a ward of 68 injured patients to have only 1 or 2 temperatures above 100° F. In some wounds, we were alarmed to find large masses of devitalized and discolored muscle and fascia deep in the wound. We soon learned that this occurred in shell-fragment wounds, and was due to an actual cooking of the tissues by the red-hot foreign body.

At first, our tendency was to attempt removal of the caked sulfonamide but our further experiences led us to be more and more conservative. The wound treatment we now follow consists in a vigorous wash of the part with soap and water, then a thorough lavage of the wound, either with cotton and water or an irrigation with a stream of water or saline. Loose and obviously devitalized tissue is cut away with scissors and forceps, but the rule is that no bleeding should be produced. No attempt is made at radical debridement. Caked sulfonamides are

left alone with the knowledge that they will dissolve or come away with later slough. After mechanical cleansing, the wounds are sprayed with sulfathiazole powder to form a fine, frost-like cover over the wound. (We have used the microcrystalline sulfathiazole, because it gives a finer powder which sprays easily, does not tend to cake, is effective against the common pyogenic organisms, lasts 3 to 4 days in the wound, and does not produce a wound edema that delays healing, as often seen with the more soluble sulfanilamide.¹) In deep wounds, a suspension of the drug is injected into the wound pocket with a syringe. Surface dressings of gauze are held in place with pressure bandages or adhesive. In large wounds, plaster splints or casts have been used for immobilization. Infrequent dressings has been the rule. Of course, in wounds with much drainage, dressings were changed as indicated, but otherwise they were often left in place for three or four days or even longer if there was no pain or other indication of trouble in the wound. At each dressing the same type of mechanical cleansing, sulfathiazole spray, and pressure dressing was carried out.

Sulfonamide therapy by mouth was used in relatively few cases because in the absence of spreading infection it did not seem to be necessary. Many of the patients had had sulfathiazole for several days before we received them, and not a few had fevers as high as 104° F., which promptly disappeared on board when systemic sulfonamide therapy was discontinued. We have seen no systemic reaction which we could recognize as being due to local sulfathiazole therapy.

With this type of treatment, the wounds were relatively painless, and they became clean in a relatively short time. It was surprising to see how much apparently nonvital tissue recovered. As the wound became free of slough and contracted, it was frequently possible to close it by secondary suture.

Based on our observations and experience, we are firmly of the belief that the local use of the sulfonamides has made radical wound debridement unnecessary. In most cases, we believe, it is actually destructive. We have had an opportunity to observe and follow some cases in which debridement had been performed, and have compared them with similar cases treated conservatively. Those treated conservatively could be closed later by secondary suture, whereas the debrided wounds necessitated the prolonged course of skin grafts and plastic operations before healing occurred.

Cases coming to us after debridement and early suture did poorly as a group. As a rule, suture had not been performed until 3 or 4 days after injury. About half of the sutured wounds we received had to be opened completely because of infection or a large hematoma.

¹Chambers, L. A.; Harris, T. N.; Schumann, F.; and Ferguson, L. K.: The use of microcrystals of sulfathiazole in surgery. *J. A. M. A.* 119: 324-327, May 23, 1942.

Wounds sutured over caked sulfonamides invariably gave complications. In some cases there was extensive necrosis due to tension, so that the resultant wound was larger than before suture. Healing was usually satisfactory in those cases in which a small wound was excised and sutured, but these simple wounds heal without suture in about the same length of time. Because of these observations we have not performed debridement and suture except in wounds of the face as will be described later.

SPECIFIC TYPES OF WOUNDS

Through and through wounds in which a bullet or shell fragment passed completely through a part gave relatively few symptoms, unless the missile struck bone, nerves, or large vessels. As a rule the wound of exit was larger than the wound of entry. This was especially true of those caused by shell fragments. Bullets often caused no more trauma than might be expected if an ice pick were suddenly thrust through a part and pulled out. Into these simple wounds sulfathiazole was sprayed and a pressure bandage of elastic webbing was applied. A patient with a through and through wound of the leg or thigh was usually able to be up and walking 4 or 5 days from the time of injury and the wounds were healed in a week to 10 days. We have not seen a single case of infection develop in a patient treated in this manner.

Wounds of the face were usually not deep, were easily cleaned up, and could be sutured without tension with a good chance of primary healing because of the excellent blood supply. We have used the same formula of mechanical cleansing, fine spray of the wound with sulfathiazole, and pressure dressings, using fine, alloy-steel wire as suture material. In wounds involving the mouth, suture is especially recommended. These patients, drooling saliva and unable to eat, are pitiful cases, yet it is in this group of casualties that we have had some of our most happy results from wound suture.

Chest wounds of all kinds have appeared. Through and through wounds caused by bullets may cause almost no symptoms or signs. Many patients with shell fragments in the lung may spit blood for a day or two, and have no other symptoms. Hemothorax and hemothorax were quite common. We have treated these patients conservatively, aspirating only when respiratory embarrassment suggested intrathoracic pressure or for diagnostic purposes if the clinical picture suggested infection. Temperatures ranging as high as 103° to 104° F. were frequently seen in patients with sterile hemopneumothoraces, sometimes persisting as long as 2 weeks. Blood transfusions were often indicated in the conservative treatment of these cases.

We have had few sucking wounds of the chest. In one case a large defect in the chest wall could not be closed by suture but required packing and an air-tight vaseline gauze dressing until the mediastinal structures stiffened enough to prevent "flutter." A second case presenting a small wound was easily closed by suture after a suspension of sulfathiazole microcrystals was instilled in the pleural cavity. Improvement in the patient was immediate.

Complications in cases with chest wounds have been rare. In over 75 cases with chest wounds and intrathoracic injury, we have had only one death. This patient, recovering nicely from a bayonet wound of the right lower chest with hemopneumothorax, died suddenly of a pulmonary embolus. We have seen very few empyemas, but it must be stated that some of our cases may have developed infection after leaving the ship.

Abdominal wounds have not been numerous in our experience. None have been received early enough to permit an exploratory operation. Three of our six deaths occurred in patients with abdominal wounds received from ships where medical facilities did not permit an exploratory operation. These patients were admitted too late to permit operation aboard here and death resulted from peritonitis in two cases and necrotizing retroperitoneal cellulitis in one. We have had an opportunity to observe numerous cases which had been operated upon before we received them. Those with sutured perforations of the small gut and stomach seemed to do well and the wounds healed primarily. Patients with perforations of the large gut did not progress so well. The abdominal wounds nearly always became infected and usually separated completely. We believe it might be better practice not to close the skin and subcutaneous tissues in these cases. Fistula formation was not uncommon.

Wounds of joints, as might be expected, did not do as well as wounds of other soft tissues. Those of the lower extremity, especially the knee and tarsal joints, give considerable pain even when immobilized. Effusion of the knee joint is quite common both from foreign bodies in and around the knee, and from trauma to the legs or body at some distance away from the knee. Aspiration was employed to relieve the tension pain of a large effusion, incision and drainage for an infected effusion, and in some cases arthrotomy with removal of foreign bodies and fragments of fractured cartilage and bone. It has been our policy to do as little surgery in these cases as possible. Sulfathiazole suspension was instilled into such joints and an adequate cast applied. It is probable that considerable disability will result in many of these patients.

Anaerobic infections have been extremely rare in our observations of the wounded. We have seen no case of tetanus and only one of gas gangrene that we recognized as such. There are many cases in which

gas may be demonstrated in the tissues, in the liquefied necrotic material draining from the wound and in the x-ray. In many of these patients the gas is air driven into the tissues with the shell fragment, and the devitalized muscle is the result of the trauma and the hot shell fragment. In the patients we have seen, the clinical picture has not been typical of gas gangrene nor has the laboratory been able to make a positive diagnosis. We have held to a conservative course in treating these patients, employing the same regime as outlined for other wounds, stressing the local and systemic use of sulfathiazole and immobilization of the wounded part. To date we have found it necessary to resort to amputation in only one case for gas gangrene. We would like to recommend at least a trial at conservative therapy in dealing with these cases before radical surgery is decided upon.

Foreign bodies in the tissues represent the most frequent type of surgical lesion, and these appear in abundance. Some patients may have literally hundreds scattered throughout the tissues. The vast majority of them give no trouble and are left alone. Our policy has been to remove foreign bodies when they produce an infection, when they lie in joints, when they produce pain or other symptoms by pressing upon or involving vital structures. Less often foreign bodies may be removed when they are easily accessible by an operation that does not produce more harm than the presence of the foreign body in the tissues warrants. Occasionally it may be wise to operate for psychological reasons. The x-ray is a great help in localizing the foreign body in the tissues. To be of maximum help a skin marker should be placed over the wound of entrance, and A-P and lateral views taken. Oblique views are of little help and often confusing. The shell fragment is usually found in a pocket of discolored organized fibrin, without much evidence of pus or infection. These wounds are sprayed with microsulfathiazole and are not sutured. Pressure dressings are used to obliterate the wound cavity and prevent serum and blood collection.

The foreign bodies that have been treated conservatively frequently may be picked out with forceps or hemostat without anesthesia when liquefaction necrosis of the missile course enlarges its tract.

One danger which must be constantly borne in mind in dealing with battle casualties is that of secondary hemorrhage. This may occur at any time after the injury, as necrosis weakens the vessel wall or a vessel itself may be torn or completely severed but not bleed until there is an eventual weakening of the wall of clot around its severed end. Foreign bodies which produce relatively small wounds may be associated with large pulsating hematomas with the constant threat of massive hemorrhage. Hemorrhage from open wounds may usually be adequately controlled by firm packing and pressure bandages. We

believe the only safe method of treating a pulsating hematoma is by ligation of the involved artery and its accompanying vein. No peripheral vascular complications have arisen from this practice. Transfusions have been employed without delay, because it has been our feeling that the systemic effect from hemorrhage is relatively slight if the blood loss is immediately replaced. Delay of even a few hours does not give the same happy results.

SUMMARY

Observations on the treatment of wounds are presented from our experience with battle casualties that have been treated aboard the U. S. S. ———.

Mechanical cleansing, local sulfathiazole, pressure dressing, and immobilization has proven the most effective method of wound treatment in our hands.

With the local use of the sulfonamides, radical debridement appears unnecessary and in many cases actually destructive.

In most cases early wound suture is not only unnecessary but is an actual hindrance to eventual wound healing. Wounds of the face and mouth are an exception to this rule.

Complications have been few and the mortality low in chest wounds treated conservatively. Tapping is performed in hemothorax and hemopneumothorax only for respiratory embarrassment or for diagnosis when infection is suspected.

It is suggested that in cases of colon perforations, suture of the muscle and fascial layers only should be attempted in closure of the abdominal wound.

Our experience leads us to the belief that conservative treatment deserves a fair trial in cases of suspected gas gangrene.

Our policy has been to remove foreign bodies when they produce infection, when they lie in joints, or when they produce pain or other symptoms by pressing upon or involving vital structures.

Secondary hemorrhage is a constant threat for which adequate emergency treatment must be available.

These conclusions have been arrived at after an experience with more than 4,000 casualties handled with a mortality of 7 patients (0.18 percent).



No infection occurred in 28 compound fractures of long bones treated by immediate splinting, generous sprinkling with sulfonamides, treatment of shock, debridement, and closure if seen during the first 8 hours.—
Frankel, C. J. and Funsten, R. V. J. A. M. A. 120: 1384,
Dec. 26, 1942.

EXPERIENCES OF THE SURGICAL SERVICE OF THE UNITED STATES NAVAL HOSPITAL, AUCKLAND, NEW ZEALAND, WITH CASUALTIES FROM THE INITIAL SOLOMON ISLANDS ENGAGEMENT¹

By GEORGE CRILE, Jr., Lieutenant, Medical Corps, United States Naval Reserve

The personnel of this hospital arrived at Auckland on July 19, 1942, and erected and equipped their prefabricated steel buildings in a period of 30 days. The medical officers had been in charge of the construction of the hospital and this phase of our work did not stop until the day before the patients arrived. Barracks and wards were completed just in time to allow the beds to be set up a day or two before the hospital was filled. Under the circumstances it was amazing to the medical officers to find that the wards and operating rooms were adequately equipped with all essentials. When the patients arrived we found that we could make them comfortable and could carry out whatever procedures were necessary.

On August 20, the U. S. S. ——— transferred to us 366 patients. All but 20 of these patients were suffering from injuries received between August 7 and 9 in the Solomon Islands engagement.

The casualties were of three main types: Gunshot wounds received during landing operations and on the beaches; wounds received aboard ship as a result of shell fire; and burns received aboard ship. Fortunately, the patients had had the benefit of excellent care prior to the time that they came to us.

Most of the patients had received some type of first-aid treatment at or near the scene of action, but this consisted for the greater part in simple application of a dressing, or in some cases of the insertion into the wound of sulfanilamide. Definitive treatment usually had been deferred for from 8 to 32 hours, at which time the necessary surgery was done aboard the transports. Five days after the engagement the patients were transferred to the hospital ship and in many instances additional surgical procedures were carried out aboard that ship.

The burn patients had been treated with tannic acid jelly before they were transferred.

By the time the patients reached this hospital the injuries were from 11 to 13 days old and all urgent surgery had been taken care of. Nearly all the compound fractures of the extremities were in plaster, and some soft tissue wounds had been similarly immobilized. The majority of the patients were reasonably comfortable and in good condition.

The wounds were remarkably clean. Although this fact is a tribute to the excellent care the patients had received aboard the transports and on the hospital ship it must also be remembered that many of the

¹ Received for publication December 18, 1942.

wounds and burns were incurred in the clean environment of a ship, and that the wounds received ashore were almost without exception caused by rifle or machine-gun bullets. The wounds therefore healed well in spite of the fact that owing to the nature of the engagement, definitive treatment was often deferred beyond the optimum time. There was only one death aboard the hospital ship and only one additional death after the patients were landed at Auckland.

Although infection was neither as prevalent nor as severe as we had anticipated, the treatment of infected wounds still constituted our chief problem. Approximately 15 percent of all wounds and burns were grossly infected and in some instances severe infections with cellulitis and systemic reaction were present. For the greater part, however, the patients were afebrile and comfortable.

For the purpose of summarizing our experiences with these patients it is necessary to divide them somewhat categorically into groups. In many instances several types of injury coexisted in the same patient. For example a patient might have a burn and a flesh wound, or a compound fracture and an injury of a peripheral nerve. When two major injuries were received by the same patient each injury has been listed separately, thus making the total number of injuries exceed the total number of patients. When minor flesh wounds coexisted in a patient with a compound fracture, the flesh wounds were not listed and the case was classified merely as a compound fracture.

The various types of injuries occurring in these cases are listed in table 1.

TABLE 1.—*Types of injuries*

Diagnosis	Number of cases	Percent	Diagnosis	Number of cases	Percent
Flesh wound.....	114		Injury of tendon.....	6	
Clean.....		88	Fractured jaw.....	6	
Infected ¹		12	Simple fracture.....	6	
Compound fracture.....	104		False aneurysm (arterial hematoma).....	5	
Clean.....		86	Concussion.....	4	
Infected ¹		14	Fractured skull.....	4	
Burn, second degree.....	40		Perforating wound of abdomen.....	4	
Clean.....		83	Neurosis (developing after the engagement).....	3	
Infected ¹		17	Deafness (marked, bilateral).....	2	
Burn, third degree.....	6		Injury spinal cord.....	2	
Clean.....		0	Contusion.....	1	
Infected ¹		100			
Injury of peripheral nerve.....	30				
Injury to eye.....	18				
Amputation (traumatic or surgical).....	11				
Penetrating wound of chest.....	10				
Soft tissue defect requiring plastic operation.....	7				
			Total.....	383	
			Deaths.....	1	

¹ In this survey a wound was not considered to be infected unless cellulitis, a systemic reaction, or a profuse purulent discharge was present. Wounds showing smaller amounts of purulent or seropurulent discharge were not listed as infected.

² 10 partial.

FLESH WOUNDS

Treatment prior to entry.—Nearly half of the patients with flesh wounds had been subjected to operation prior to their admission. In

most instances the operation had consisted of debridement of the wound, removal of the foreign body, and implantation of either sulfanilamide or sulfathiazole. In some cases large cakes of sulfathiazole still remained unabsorbed in the wounds.

In only a few cases had primary closure of the wounds been attempted, and most of these became infected and had to be reopened aboard the hospital ship. The infection in these cases appeared to be more severe than in those in which the wound was not closed. When one considers the fact that definitive treatment was of necessity deferred well beyond the optimum time for primary closure, it is not surprising that infection occurred.

The wounds which received no surgical treatment at all, except perhaps the introduction of sulfanilamide appeared to do as well as those which had been subjected to surgical revision. Wounds containing large metallic foreign bodies often appeared to be as free of infection as the wounds which had been treated by debridement. In view of the fact that operation was in most instances deferred beyond the optimum time for debridement and since the wounds were all received under relatively clean conditions, this finding is not surprising. It is difficult to see how surgical excision of a wound 24 hours old, received under clean conditions and in all probability infected only with organisms of low virulence, could do more than destroy healthy tissue and open up tissue planes that were previously protected.

The presence of metallic foreign bodies did not appear to have a deleterious effect on wound healing except when large foreign bodies were present in relatively superficial wounds. In these circumstances sinuses often persisted in draining seropurulent material until the foreign body was removed. The deeper the foreign body was located the less likely it was to cause a draining sinus or give any symptoms. The incidence of cellulitis and severe infection did not appear to be materially increased by the presence even of large metallic foreign bodies.

CASE REPORT

MULTIPLE FLESH WOUNDS OF LEGS AND THIGHS INFLICTED BY A FRAGMENT OF A SHELL

Type of injury.—Injury occurred aboard ship. Fragment of a shell.

Previous treatment.—First-aid treatment consisted of application of a dressing. Twelve hours later sulfanilamide was packed into the wounds.

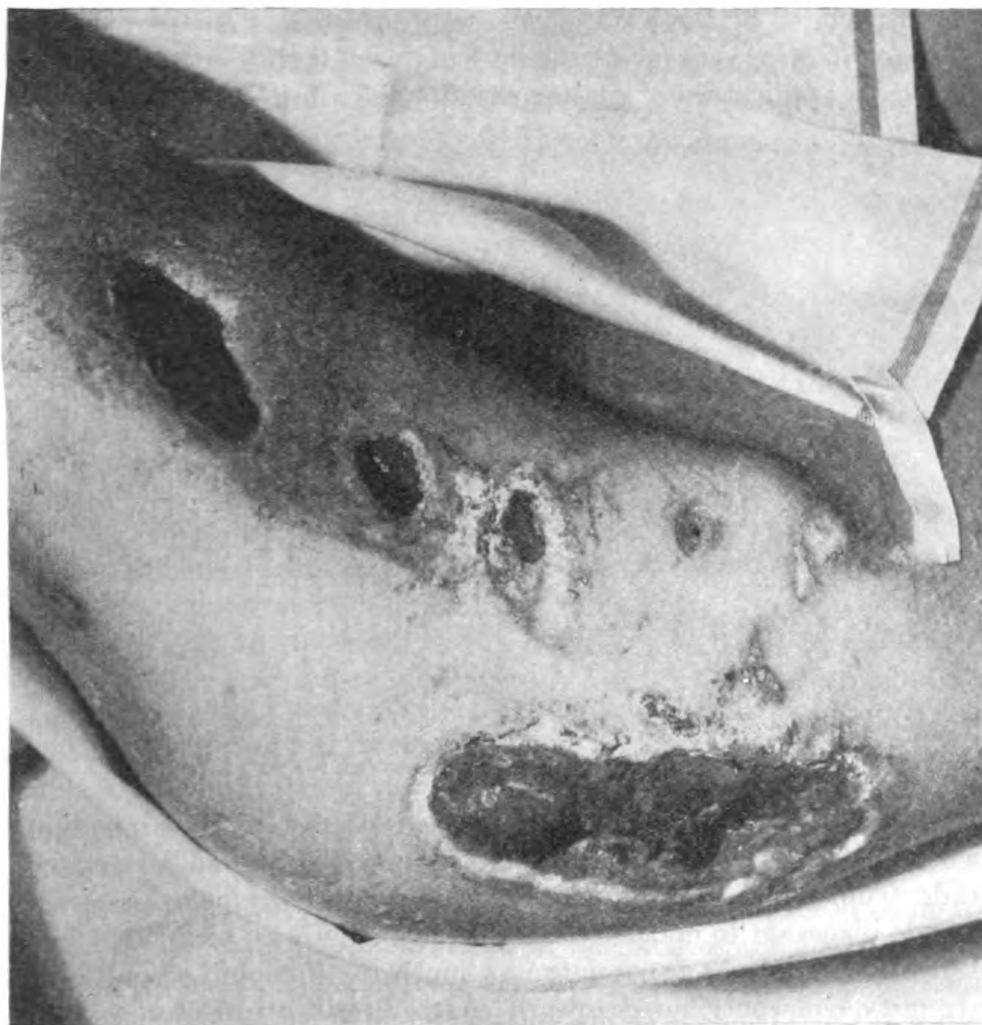
Examination.—Cleanly granulating shell wounds of thigh, the longest one approximately 8 inches in length and 2 inches wide (fig. 1).

Treatment.—Application of sulfanilamide powder and saline dressings.

Course.—The wound granulated cleanly and the patient had no pain or other complaints. Application of a skin graft to the defect was considered but a small draining sinus in the center of the wound rendered it unfit for grafting. An x-ray taken to determine the presence of a foreign body showed a metallic

fragment 5 inches long and 1 inch wide located close to the hip joint (fig. 2). This foreign body could be felt with a probe, and its tip could be grasped with a hemostat. Without anesthesia and without undue discomfort to the patient, the piece was grasped with a hemostat and withdrawn. Following this the wound healed promptly.

This case indicates that large foreign bodies may lie almost innocuously in the tissues for long periods of time. In only one

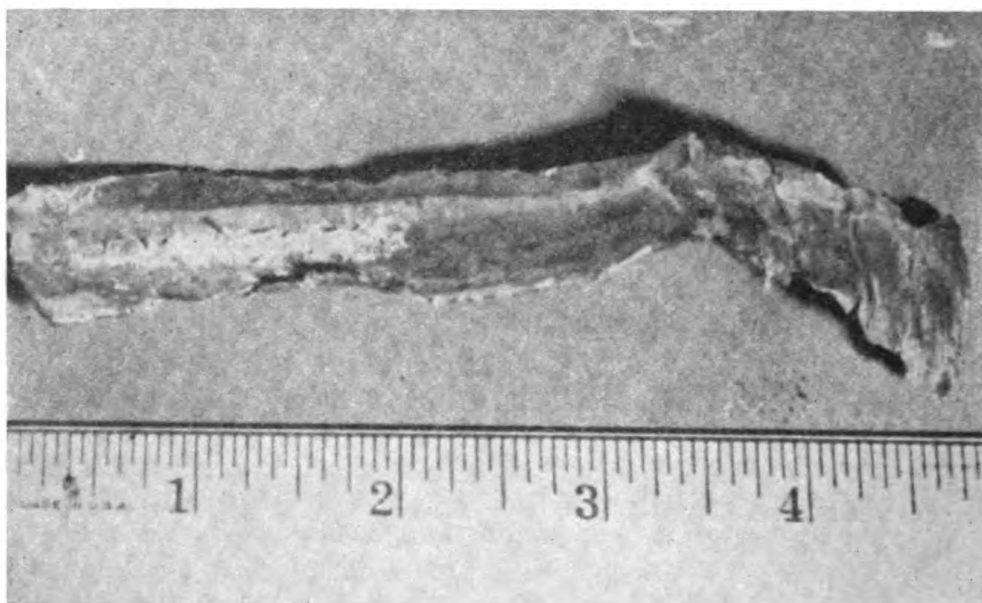


1. (CASE 1) SHELL WOUNDS OF THIGH.

instance did a cellulitis develop around a metallic foreign body, and in this case a compound fracture was also present and may have been a factor in the production of the reaction. Although it would be unwise to draw sweeping conclusions from this small group of cases, in which the wounds were received in an unusually clean environment, it was nevertheless true that the patients whose wounds were not debrided and who did not have operations for removal of the foreign bodies, appeared to do as well as those who were subjected to extensive operations.

Infection.—Most of the flesh wounds were still draining at the time the patients were admitted. The drainage in the majority of cases was serous or seropurulent, and unquestionably an element of infection was present in most of these cases. For purposes of classification, however, the wounds were not considered to be infected unless cellulitis, tenderness, a large amount of purulent discharge, or a systemic reaction was present. Twelve percent of the 114 flesh wounds, judged by these standards, were infected.

Immobilization.—Some of the patients with flesh wounds had been treated by application of plaster casts to the affected part. Most of



2. (CASE 1) FRAGMENT OF SHELL REMOVED FROM THIGH.

the wounds so treated did well and healed cleanly without infection. In some instances, however, the patients were observed to have a low-grade temperature and the casts were therefore removed and the wounds inspected to make certain that drainage was adequate.

At first we did not appreciate how much the immobilization of the extremity had contributed toward controlling the infection, and in some instances the extremities were removed from the casts and the dressings were changed frequently in an effort to "keep the wound clean." We soon observed, however, that the patients with infection who were subjected to frequent dressings involving movement of the affected part, did not do as well as those in which the dirty dressings were left in place in the plaster. When the extremities were moved and disturbed the patient was subjected to unnecessary discomfort and in many instances the severity of the infection as judged by the temperature and the local manifestations of cellulitis was increased. As soon as we had assured ourselves that adequate drainage had been

provided, the extremities were again immobilized in their bivalved plaster shells, and were not dressed more frequently than twice a week. This treatment, provided of course that drainage was adequate, gave better results than hot soaks or any form of treatment involving frequent dressings, irrigations, or application of sulfonamides.

Following the acute phase of the infection the majority of the wounds filled in rapidly and healed promptly.

Secondary closures.—Secondary closures of gaping wounds and relatively large tissue defects were performed as soon as the wounds were clean. In spite of the fact that many of these wounds were closed under great tension none of them broke down and uniformly good results were obtained.

The technic of secondary closure consisted of:

1. Excision of granulation and scar tissue.
2. Undercutting skin edges.
3. Avoiding use of catgut ligatures. (Bleeding controlled by pressure.)
4. "Frosting" with sulfanilamide powder.
5. Closure with No. 32 steel wire sutures taking large bites of skin.
6. Inserting small rubber wick into dependent portion of wound if infection or uncontrolled bleeding were present.
7. Pressure dressing and immobilization.

Secondary closure of wounds provides for quicker healing and gives a better end result than do skin grafts, and whenever possible should be used instead of grafts.

The use of the sulfonamide drugs.—Nearly all the patients with flesh wounds had been treated by the local application of sulfanilamide or sulfathiazole prior to their admission to the hospital. The most dramatic effects of this treatment had been to prevent the development of infection, and the relatively low incidence of serious infections can probably be attributed to the liberal use of sulfonamides as much as to any other single factor.

Neither local nor oral use of the sulfonamides produced dramatic results in the cases in which infection was well established. In most of these cases the infection had developed in spite of early and adequate use of these drugs, and hence it could be assumed that the infecting organisms were not of a type that could be expected to respond readily to this form of therapy. More important still were the local factors in the wound which inhibited the action of the drugs.

Ever since Lockwood demonstrated that pus, necrotic tissue, and the products of proteolysis had a strong inhibitory effect on the bacteriostatic and bactericidal powers of the sulfonamide drugs, it has been widely recognized that the sulfonamides are not effective either when given orally or when used locally where pus is present and when pockets and abscesses allow the inhibitory factors to accumulate and

interfere with the efficacy of the drug. Abscesses must be drained, necrotic tissue must be removed, and flaps that cause pockets, and recesses in which pus can accumulate must be debrided before the sulfonamides can be efficacious. Only after such wounds have had adequate surgical revision does the local application of sulfonamides exert any appreciable effect. Vaseline gauze dressings used on infected wounds appeared to dam back the exudate and cause the sulfonamides to lose their potency.

Sulfathiazole was not given by mouth to the patients suffering from purely local manifestations of infection. Only in patients with extensive cellulitis or with elevations of temperature was sulfathiazole given orally. Since the sulfonamides are slowly absorbed from wounds it is reasonable to suppose that effective concentrations of the drug cannot penetrate deeply enough into the tissues to check the advance of an extensive cellulitis and that under these circumstances it is well to supplement the local action by the oral administration of the drug. In cases when the infection is superficial, however, the concentration of the drug in the involved tissues has been shown to be several hundred times as high as can be obtained by oral administration, so that in these cases it is useless to give the drug by mouth. Although the effects of the combined local and oral administration of the sulfonamides rarely resulted in dramatic subsidence of temperature or rapid clearing of the local signs, it is quite likely that the spread of the infection was often checked, for in no cases did the cellulitis advance nor did septicemia develop.

It is difficult to introduce sulfanilamide powder into cavities or to insert it against the force of gravity unless a good powder blower is available. Ordinary atomizers will not spray powder and are useless. "Asepto" syringes are fairly satisfactory but are not as good as a true powder blower. If powder blowers are not available much sulfanilamide will be wasted by inaccurate and ineffective application and it will be impossible to place the powder at the desired point.

When it is desired to instill sulfanilamide into a sinus tract it can be suspended in emulsion form in warm water and introduced from a syringe through a catheter.

Chlorine antiseptics.—Recent investigation has indicated that the chlorine antiseptics, such as Dakin's solution and azochloramide, have a specific effect in increasing the local action of the sulfonamide drugs. This effect is probably due to their ability to combine with or to neutralize the products of proteolysis which would otherwise inhibit the action of the sulfonamides. When azochloramide and sulfanilamide powder were introduced into abscess cavities or into wounds filled with pus and necrotic tissue, the results obtained appeared to be much better than those obtained by the use of either

alone. In most instances the 1:500 solution of azochloramide in glyceryl triacetate was used.

Dressings.—The problem of dressing certain patients whose wounds presented large raw areas to which the gauze became adherent was a serious one. In many instances the patients experienced much pain when the dressings were removed and in several cases it was necessary to give a little pentothal analgesia. Therefore until such a time as the wounds became less painful to dress we merely covered them with clean wax paper or cellophane. Perforated cellophane, allowing the exudate to drain through into the dressings yet keeping the dressings from sticking to the wounds, would have been ideal for this purpose but was not available. The wounds treated in this way cleaned up as rapidly as those dressed with the conventional gauze and bandages and the patients were spared the discomfort of painful dressings. In one case, a patient with extensive wounds of the buttocks and posterior portion of the thighs, the dressings were nearly impossible to keep clean, and the wounds were kept cleaner and the odor was less when the patient was allowed to lie on wax paper with no dressings on the wounds.

When large raw surfaces were present, such as follow third degree burns or avulsion of tissue by fragments of shells, the final stages of preparation for skin grafting could not be carried out by application of dressings of this type. The preparation of these surfaces will be discussed later under the heading of "Burns."

Metallic foreign bodies.—Persisting sinuses in most instances indicated the presence of a foreign body—metal, pieces of clothing, or often a combination of the two. Cellulitis was rarely present in these wounds and the majority of them were quite symptomless except for a persistent seropurulent drainage. In the vast majority of cases the foreign body could be located with a probe, grasped with a hemostat and withdrawn without the use of an anesthetic. Occasionally it was necessary to anesthetize the skin with novocaine and enlarge the wound of entry before the fragment could be withdrawn.

Metallic foreign bodies imbedded deep in the tissues rarely give symptoms. Pieces of metal up to 3 centimeters in diameter may be imbedded in the soft tissues without causing pain or discomfort. In most instances in which pain was at first attributed to the presence of a foreign body, more careful analysis showed that the pain was the result of an injury to a nerve with an attendant traumatic neuritis. In no instance was the foreign body located in such a position that it could be responsible for the nerve irritation and in every case the symptoms subsided spontaneously without necessitating removal of the fragment.

We did not find it necessary to remove any metallic foreign bodies except those fragments which were causing a draining sinus or which

were located subcutaneously. The superficially located fragments cause a lump or area of slight tenderness of which the patient is conscious and since they are so simple to remove it is usually best to do so.

When operating for the removal of pieces of shrapnel it is well to localize the fragment in relation to a skin marker by either x-ray or fluoroscope. Occasionally a very tiny fragment surrounded by a hematoma or area of tissue reaction may cause a relatively large tumor. If one relies merely on the written x-ray report and does not check the exact relationship of the foreign body to the area of swelling, occasionally the operator will fail to find the large fragment and will waste much time exploring the wound for the tiny fragment which was causing the subcutaneous swelling. It is also well to remember that fragments may penetrate or traverse bones without fracturing them and that lateral as well as anterior-posterior localization by x-ray is helpful. In one case a tiny fragment of metal traversed the mandible without fracturing it. Exploration of the lateral aspect of the jaw revealed only a hole in the bone. X-ray showed the fragment on the inside beneath the mucosa of the mouth.

COMPOUND FRACTURES

Practically all of the compound fractures of the extremities had been immobilized in plaster aboard the transports or on the hospital ship. Nearly all of these wounds had been treated with the local application of sulfanilamide or sulfathiazole and had been left open. Those in which an attempt was made to close the wound became infected and had to be reopened.

The general appearance of the wounds of the patients with compound fractures was practically the same as that of the wounds of the soft tissues. The incidence of frank infection, judged by the same standards as have been outlined in the discussion of wounds of the soft tissues, was 14 percent, only 2 percent higher than the incidence of infection in the wounds of the soft tissues.

The position of the fractured ends was of course only fair and in many cases there was considerable overriding. Prior to the time the patients reached Auckland, they had been aboard ship and had undergone several transfers which of course made it quite impossible to continue satisfactory traction. Fortunately the majority of cases responded well to the traction used after their admission to the hospital even when 3 weeks or more had elapsed since injury; roentgenograms, in most of the cases, showed satisfactory formation of callus.

Complications, in the group of patients with compound fractures, were few. There was one instance of a severe secondary hemorrhage

occurring into a cast without external evidence of bleeding, and in this case the profunda branch of the femoral artery had to be ligated. The wounds in the vast majority of cases appear to be healing satisfactorily.

BURNS

Forty-six patients were admitted with burns. The great majority of these were caused by the flash of explosions aboard ship. Most of the burns were superficial (second degree) and in all but one case the burns had been treated by the application of tannic-acid spray or jelly. Some had been treated immediately aboard ship and in other cases treatment was of necessity deferred for a number of hours during which time the burns were exposed to salt water and oil. Delay in treatment did not appear to effect any significant alteration in the incidence of infection or in the end results obtained.

The criteria of infection used in connection with the study of burns were more rigid than those followed in judging the wounds. If any pus was present at any point, the burn was considered to be infected. Although in the second-degree burns infections of sufficient severity to form pus beneath large areas of the eschar or to result in systemic evidence of sepsis were present in only 15 percent of the cases; in 29 percent of all second-degree burns some evidence of infection was present. All of the third-degree burns were grossly infected.

Tannic acid had been used indiscriminately on hands and faces but fortunately in most instances the burns were superficial and healed excellently without scarring or contractures. There was no gangrene of the fingers and as a result of the early removal of the eschars and institution of active motion there were no stiff joints. The tannic-acid eschars on the second-degree burns could rarely be removed before 12 days, and in the case of third-degree burns 4 to 6 weeks often elapsed before the eschars could be completely removed. It was our impression that the application of tannic acid to third-degree burns prolongs convalescence and makes it necessary to defer skin grafting longer than would otherwise be necessary.

Removal of eschars.—Vaseline, a 1:500 aqueous solution of azochloramide, and saline dressings or soaks were the agents found most effective in softening up the eschars and facilitating their removal. In the infected cases, wet fine-mesh gauze dressings and the application of an aqueous solution of azochloramide, followed by the local application of sulfanilamide powder appeared to give the best results.

One case had been treated by Aldrich's triple-dye technic and in this case, although the burn was undoubtedly more severe than most, the infection was also more severe and the eschar was harder to remove than in any of the cases treated with tannic acid. The last of the

eschar could not be removed until 6 weeks had elapsed after the patient had been burned.

Skin grafts.—In all of the patients with third-degree burns skin grafts were applied as soon as the granulating areas had been cleared of infection. Five split-thickness (Thiersch) grafts were used and one pinch graft. The results obtained with the split-thickness grafts were far superior to those obtained by the pinch technic. Healing was more rapid and complete, and the end results were better. It was our impression that pinch grafts are best reserved for areas which cannot be rendered clean enough for a split-thickness graft to take. All of the split-thickness grafts were applied between four and six weeks after the patient was burned and good takes were obtained in all cases.

Preparation for grafts.—The use of the sulfonamides alone does not always clean up the infection and prepare the granulating surface for grafting. Often the granulations remain boggy and edematous and continue to be covered with purulent exudate in spite of the daily application of either sulfanilamide or sulfathiazole powder. The combined use of moist saline dressings and sulfanilamide resulted in striking improvement of many of these wounds, but the best results were obtained when the wounds were:

1. Sprinkled with sulfanilamide.
2. Dressed with fine-mesh gauze saturated with a 1:500 solution of azochloramide in glyceryl triacetate.
3. Covered with gauze dressings saturated with saline.
4. Bandaged with an elastic bandage to give pressure.
5. Kept moist with saline injected into the dressing through catheters.

Moreover whenever the burn was on an extremity, this was elevated to afford dependent lymphatic drainage. Forty-eight hours after this type of dressing was applied usually there was produced a clean, firm, red, granulating surface on which skin could be grafted without necessitating cutting off the granulations. The dressings were usually changed only twice during this 48-hour period.

Sulfanilamide, when not inhibited by the presence of pus and products of proteolysis, will quickly clean up most infections that may be present on a granulating surface, but if pockets, recesses, or sinuses in which pus can form are present, the sulfanilamide will be inactivated and the infection will persist.

The combined use of sulfanilamide and azochloramide appeared to be much more effective than the use of either drug alone.

The pressure dressings not only reduce the amount of exudate and thus decrease the inhibitory effect that this exudate will have on the sulfanilamide, but also reduce the edema of the granulations and make them firm, vascular, and ready for grafting.

The moist dressings prevent caking of the sulfanilamide powder and allow free drainage of the exudate. If dry dressings are applied they soon trap further secretions beneath an impervious layer of caked exudate and thus inhibit the activity of the sulfanilamide.

If the extremity is elevated, gravity aids in reducing the edema of the granulations, and the exudate appears to diminish in amount. It is thus clear that each step in this plan of treatment plays a part in diminishing or removing the exudate or in neutralizing its inhibitory effects on the activity of the sulfonamides.

The oral administration of the sulfonamides did not seem to be of any particular value in the treatment of infections in which pus had formed beneath eschars.

Fatalities.—The only death that occurred was in a patient with extensive infected second- and third-degree burns of 70 percent of the body surface. This patient expired on the second day following his admission to the hospital. Sepsis was the cause of death.

INJURIES OF PERIPHERAL NERVES

Thirty patients were admitted with injuries of the peripheral nerves. The commonest site of injury was in the leg or thigh. Many of these injuries were associated with compound fractures or with wounds which had not healed sufficiently to enable the surgeon to anastomose the ends of the nerve in a clean field. For this reason no attempts were made to suture the nerves and treatment was directed to promote healing of the wound and to maintain the affected part in such a position that contracture of the muscles would not occur.

Traumatic neuritis giving rise to considerable paresthesia, pain, and discomfort occurred in 29 percent of the cases, and in some instances, the pain was most difficult to control. Aside from morphine, the use of which was avoided in these cases, codeine in doses of 1 or 2 grains coupled with 10 grains of aspirin was found to be the most effective analgesic.

Injuries of the nerves in the arms appeared to give the greatest amount of discomfort. Patients with injuries of the nerves of the legs did not as a rule require much sedation. In one instance a penetrating wound of the flank had divided the ilio-inguinal nerve and produced a very severe neuralgic type of pain.

When pieces of shrapnel were present imbedded in the muscles of an extremity and the wound of entry was well healed, there was a marked tendency on the part of both patient and attending physician to attribute the pain to the presence of the foreign body. In every case in which this occurred a careful sensory examination indicated that there had been an injury to a peripheral nerve and that the symptoms were caused not by the presence of the foreign body but by a traumatic

neuritis. In no instance was the foreign body found to be lying on or near the nerve so that the nerve could have been irritated from its presence. In all of these cases the symptoms of traumatic neuritis subsided spontaneously in from 1 to 6 weeks, and only in those cases in which sinuses persisted in draining was it found to be necessary to remove the foreign body.

INJURIES TO THE EYE

There were 18 patients who had sustained injuries of the eye. In half of these cases the injury was of sufficient severity to necessitate enucleation. In the majority of these cases the eye had been removed before the patient was admitted to the hospital. In the case of many of the injuries to the eye, the lids were also damaged and plastic surgery will eventually be necessary.

AMPUTATIONS

In 11 cases amputations, either traumatic or surgical, had been done. The majority of the amputations were of the guillotine type and had been left open. No amputations were necessary after the patients were admitted to the hospital. In most instances the amputation had been surgical, necessitated either by infection or by practically complete severance of the affected member. In only one case had the amputation been done for proved gas gangrene, although in several other badly infected cases the surgeon had suspected the possibility of a gas-bacillus infection. The low incidence of gas gangrene and absence of tetanus was a striking feature of the wounds sustained in this engagement and can probably be explained by: (a) That many of the wounds were received aboard ship; (b) the wounds received on shore were mainly clean gunshot wounds; (c) the soil was not highly cultivated; (d) all of the patients had been actively immunized against tetanus with toxoid and "booster" injections; and (e) the sulfonamides were used freely in the prophylaxis and treatment of infection.

It was remarkable how little immediate discomfort the loss of an arm produced. One boy stated that a shell struck near him and he was aware of being whirled around and knocked against the bulkhead. Upon recovering his balance he noticed an arm lying on the deck and made a mental note of sympathy for the man who had lost it. Then he noticed a familiar looking ring on the finger and realized that it was his own arm. He had experienced no pain and did not have pain for several hours.

Later, however, the patients with amputations experienced considerable pain. Unpleasant sensations were often referred to the missing extremity, and dressings in most instances were agonizingly painful, necessitating occasionally the use of pentothal anesthesia. In many

instances the skin flaps were too short and could not be pulled down to cover the raw end of the stump. As a result there was a protracted period during which the dressings were a severe ordeal.

Whenever possible the skin was pulled down by adhesive traction or by traction exerted on sutures inserted through the edges of the skin. In this way the skin could often be closed, but in other instances the stump had to be revised and occasionally it was clear that skin grafts would be required. It was our impression that much difficulty with the final stump and much discomfort during the process of healing could have been avoided if longer flaps of skin had been left, or if a different type of amputation had been done, at least in some of the cases which were not badly infected. In addition trouble would have been avoided if traction on the skin flaps had been applied as soon as possible.

We soon found that it was practically impossible to remove gauze from amputation stumps without pain even when the greatest care and patience was used in soaking it off. In some instances therefore, the stump was merely covered with a piece of cellophane or rubber dam. Strips of cellophane of suitable size are available on cigarette packages and can be cleaned by immersion in an antiseptic solution. Wet dressings, sulfonamides, and applications of azochloramide were usually used in the final stages of preparation of a stump for revision or closure, but healthy granulations were obtained beneath the cellophane or rubber and the patients were spared much discomfort while waiting for the wounds to fill in and the infection to subside.

PENETRATING WOUNDS OF THE THORAX

There were 10 patients with penetrating wounds of the chest and in no case was surgery necessary. In most instances varying degrees of hemothorax or hemopneumothorax had developed, but in the case of only 2 of the patients had it been necessary to aspirate blood from the pleural cavity prior to their admission to the hospital. One of these patients had been tapped twice because of severe dyspnea and cyanosis. A pleural effusion developed in one case and in another a femoral phlebitis occurred. There was no infection and in no instance was it found necessary to withdraw fluid after the patients were admitted to the hospital.

In none of these cases had any surgery been attempted prior to their admission to the hospital other than simple debridement of ragged wound edges. In the case of the patients whose wounds were caused by bullets, the projectile had traversed the chest and had emerged leaving a surprisingly small wound of exit, even in those cases in which ribs had been hit. In one instance a small-caliber rifle bullet had traversed the thorax without hitting the ribs and had left merely

tiny wounds of entry and exit, both of which were completely healed leaving scars less than 1 cm. in diameter 2 weeks after the wound was sustained.

In no instance did shrapnel lodge in the lung itself but in one or two instances the missile had traversed the lung and lodged in the chest wall of the opposite side.

The patients with blood in the pleural cavity almost invariably ran a febrile course with temperatures remaining quite consistently as high as 101° or 102° F. At first they often appeared to be quite sick and it was thought that an empyema was developing. But the temperature, in every case, gradually subsided to normal as the blood was reabsorbed. The administration of sulfathiazole did not appear to have any effect on the temperature curve.

SOFT TISSUE DEFECTS

There were seven cases in which there were large defects in the soft tissues necessitating the transfer of flaps or application of skin grafts. These wounds were cleaned up as rapidly as possible and grafted or closed as soon as feasible so that contraction of scar tissue would not result in permanent deformities. These plastic procedures met with uniform success as did the many secondary closures of the smaller defects.

INJURIES OF TENDONS

In six cases the chief injury was damage to an important tendon, but in many other cases tendons were severed in conjunction with compound fractures. The wounds were still draining and hence repair of the tendons was not attempted. There were no cases in which a primary repair of a severed tendon had been done.

SIMPLE FRACTURES

There were six cases of simple fracture of the extremities, all of which were uncomplicated and were treated by immobilization in plaster.

PENETRATING WOUNDS OF THE ABDOMEN

There were five patients who had had penetrating wounds of the abdomen. Four of these had been operated on in the first 8 hours and were convalescing without complications except for infections in the surgical wounds. In each case damaged bowel had been sutured.

The fifth patient had suffered multiple shrapnel wounds of the soft tissues. A tiny piece of metal, no larger than a grain of wheat,

had entered the abdomen in the left lower quadrant over the sigmoid colon and had lodged deep in the pelvis. There was no clinical evidence of injury to the bowel and for this reason a laparotomy was not done. Two weeks after the original injury, when the wound of entry was a healed and practically invisible scar, a pelvic abscess formed and was drained through the rectum. In a later group of cases a similar episode occurred indicating that serious damage to the bowel may occur from extremely small fragments, and emphasizing the necessity of careful study of every wound of the abdomen no matter how insignificant it may appear to be.

COMMUNICATING ARTERIAL HEMATOMAS (FALSE ANEURYSMS)

Five patients had injuries in which arteries had been partially severed with the formation of hematomas which communicated with the artery and hence pulsated forcibly. In each instance the hematoma was filled with old clots and fresh bright red arterial blood. The cavity was lined with a shiny, well-defined wall indistinguishable on gross examination from endothelium. In each instance the artery was only partially severed and its transverse rent was gaping open in such a way that the blood could reenter the vessel and maintain a normal pulse in the extremity. Periods varying from 3 to 5 weeks had elapsed between the time of injury and the time of operation, and in all cases the swelling was becoming larger and the pulsation more forcible as time went on. In two cases repeated hemorrhages had occurred, and in one of these (an injury of the femoral artery) further bleeding occurred subsequent to the patient's admission to the hospital.

In the case of a small communicating arterial hematoma of the lower leg an attempt was made to induce thrombosis or obliteration of the sac by the application of strong localized pressure, but this was poorly tolerated and at the end of 24 hours had affected no diminution in the size of the tumor or in its pulsation.

The treatment of choice of these lesions is, in the vast majority of instances, ligation of the vessel above and below the injury, and division of the vessel so that the ends will retract. In addition, if there is any question as to the circulation, it is said to be wise to ligate the accompanying vein. Since there was no apparent impairment of circulation in any of these cases the veins were not ligated and in no case was there any evident change in the extremity except for loss of a palpable pulse. The injured vessels were in two instances the femoral which was partially divided two or 3 inches below its profunda branch; in one the dorsal branch of the radial,

giving a miniature aneurysm in the "anatomical snuffbox;" in one the brachial, giving a brawny induration of the upper arm which was at first mistaken for cellulitis and whose true nature was proved only by inserting a needle and withdrawing arterial blood; and in the last a small artery of the lower leg giving a small pulsating hematoma in the calf.

In all cases the vessel was controlled above its site of injury prior to exploration of the hematoma. This could be done by means of a tourniquet in the case of all but the two injuries involving the femoral arteries, and in the latter, the arteries were exposed and controlled by means of untied ligatures placed around them well above the sites of injury. A tourniquet (sphygmomanometer cuff) applied below the site of injury was of value in controlling reflux bleeding from the distal end. In spite of these precautions, however, the collateral circulation was so good that some troublesome bleeding often took place.

No attempt was made to excise the entire sac. After removal of the clots, the vessel was merely ligated above and below the site of injury and divided. The sac was then scraped with gauze, washed and obliterated with a few interrupted sutures after frosting its walls was sulfanilamide to control any contamination which might be present. All of the wounds healed by first intention. The pathologist was unable to demonstrate endothelium in sections of the lining.

Although we have had no experience with arterial repair we do not believe that it would be often indicated in dealing with this type of injury. A review of the literature indicates that the incidence of secondary hemorrhage is higher following arterial suture than following ligation and that either thrombosis of the vessel or the subsequent development of a true aneurysm are common occurrences. In a later group of casualties we have observed several more communicating arterial hematomas, one involving the axillary artery just at its junction with the subclavian, and the other involving injury of both the femoral and profunda vessels. In each case the affected vessels were ligated without producing any apparent impairment of the circulation of the extremity. In the case of the injury to the femoral and profunda arteries the vein was also ligated. Since the results of ligation have been so good, we have seen no reason to attempt to repair the vessels, which in nearly every instance were cut transversely and were gaping widely open. In the case of the axillary injury, the bleeding was controlled by isolation of the subclavian at its origin in the neck but in spite of this, considerable troublesome bleeding occurred before the opening was found. It is therefore well to be prepared to transfuse these patients should the necessity arise, especially since many of them are already anemic from loss of blood.

INJURIES TO THE HEAD

Four patients were admitted with fractures of the skull and four others with post-concussional syndromes.

Several of these patients had been unconscious for a number of hours but all but two had apparently recovered completely without evidence of neurological damage. In two instances monoplegias were present and in several others such symptoms as dizziness still persisted. There were no indications for surgical intervention.

NEUROSES

Three patients were admitted with neuroses which had developed subsequent to the engagement. In each case careful questioning revealed that a fundamental instability had been present prior to the patient's entry into the service. The necessity for elimination of individuals with unstable personalities prior to their induction into the service is emphasized by such examples.

DEAFNESS

Partial deafness due to injury of the drum by concussion was a common finding and was not infrequently accompanied by varying degrees of otitis media. In only two instances however was marked bilateral deafness observed.

INJURIES OF THE SPINAL CORD

There were only two cases in which injury to the spinal cord was present. Surgery was not indicated in these cases.

CONTUSION

There was one case of severe contusion by blast. No treatment was necessary.

REMARKS

Subsequent experience with casualties received from the same area has been along the same lines. There have been greater numbers of neuropsychiatric problems arising in the troops subjected to the prolonged strain of day and night fighting. Malaria has appeared, sometimes developing as late as 30 days after exposure. The incidence of wounds of the abdomen and wounds of the head has remained lower than we would have expected. The chief problems have remained the treatment of infection and the covering of denuded areas with skin.

Pentothal anesthesia has been used more than any other type of anesthetic agent and has proved itself safe, adequate, and satisfactory for carrying out minor surgical procedures.

There has been little use for plasma. The cases seen at this hospital have been well beyond the critical phase of shock. Citrated blood has been widely used in the treatment of hemorrhage and anemia.

The most striking feature of the casualties seen at this hospital has been the rapidity with which these healthy young individuals recover from trauma or disease. The excellent medical care which has been available from the moment of injury is probably largely responsible for this phenomenon.

OS CALCIS FRACTURES IN NAVAL WARFARE¹

By W. L. ROGERS, Lieutenant Commander, Medical Corps, United States Naval Reserve

Fractures of the os calcis are relatively frequent in civilian life. The incidence is given as being 1.2 percent of all skeletal injuries. In spite of this frequency, by far the greatest number fall into the hands of a relatively few surgeons. In time of peace the incidence of this fracture is relatively low in navy life. Therefore, as in civilian life, experience in handling this type of fracture has been extremely limited.

A somewhat comprehensive review of this fracture for naval medical personnel would seem opportune at this time for the following reasons:

1. The greatly increased incidence of os calcis fractures in Navy personnel in time of war.
2. This fracture may give rise to greater disability than almost any other fracture, and it definitely should be considered the most important bony injury of the foot.
3. Because of the nature and character of this fracture, therapy lends itself rather ideally to wartime emergency conditions.

MECHANISM

In civilian life the great majority of these fractures occur as a result of a fall from a height, landing on one or both feet. The fracture acquired under these conditions is bilateral in approximately 10 percent of cases and occasionally compounded. There may also be an associated compression fracture of the vertebrae, fracture of the femoral shaft or fracture of the pelvis. This mechanism also occurs not uncommonly with Navy personnel; men falling from a height landing feet first or jumping from a deck to a dock below under emergency conditions, etc. In time of war on board ship a reversed mechanism

¹ Received for publication November 13, 1942.

presents itself as a more frequent cause of this injury. It occurs as a result of a sudden buckling of the deck on which the man is standing, this following the explosion of a bomb a deck or two below. The bilateral incidence in this latter group would seem to the writer to be considerably higher than that observed in the former group. One is much more likely to land unevenly on his feet from a fall. The force exerted upward as a result of deck buckling is more likely to be evenly distributed, affecting both feet. It has, however, been observed in our Pearl Harbor casualties that one fracture may be much more comminuted and compressed than the other. Also among those who survived, complicating compression fractures of the vertebrae or fractures of the pelvis and the femur were relatively rare. One patient was observed with a telescoping of the lower shaft of one femur with no associated fracture of either os calcis. At the time of the explosion and resultant buckling of the deck the patient was rounding a corner with all of his weight on the affected leg.

ANATOMY

Briefly, the os calcis is a narrow, elongated bone forming the heel, supporting the astragalus and joining the cuboid in front. The inferior surface presents at the back and is formed by a union of the internal and external plantar tubercles composing the posterior pier of the foot. The posterior surface is roughly oval with the small end up. The Achilles tendon is attached to its lower half. The internal surface is smooth and concave while in front and above is the shelflike process, the sustentaculum tali which supports the head of the astragalus. Approximately the anterior two-thirds of the superior surface articulates with the astragalus. There are two articulating facets, the posterior, which is the larger occupying the middle of this surface, and the anterior, running forward and outward. It begins internally on the top of the sustentaculum and ends at the most anterior point of the bone. In approximately 50 percent of people this articulating surface may be divided into two segments. The anterior surface articulates with the cuboid. The bone has a thin cortex and is filled with a very cancellous type of structure.

DESCRIPTION

Fractures of the os calcis are quite variable, several types and combinations having been described by various authors. The fracture usually involves the body, although occasionally the lower posterior portion alone may be implicated. This latter is often spoken of as a "duck bill" avulsion type of fracture, the lower posterior segment to which the Achilles tendon is attached being displaced upward and backward.

Reduction of this fracture by closed means may be difficult and may require open reduction and fixation by a screw or nailing with a pin. Another fracture which may require internal fixation by open reduction is an isolated fracture of the sustentaculum. Unless the articular surface of the sustentaculum is brought back into its normal joint relationship, the valgus deformity of the foot will probably remain with subsequent disability. Fractures of the body may be divided into fissure and crushing fractures. Considerable displacement is usually found, presenting three characteristic features:

1. The posterior portion of the heel is displaced upward as a result of the impact against the ground or the sudden upward thrust of the deck.
2. There is a resultant forward displacement with shortening of the heel.
3. As the axis weight thrust is through the tibia and is directed to the medial side of the longitudinal axis of the heel, the foot tends to pronate under the impact and since the fracture occurs with the heel somewhat everted, the posterior portion or process is usually displaced laterally.

In these "squash" type fractures of the body as a result of these three features there is apt to be derangement or disruption of the calcaneo-cuboid-astragalar junction with subluxation of the calcaneo-cuboid and astragaloscaphoid joints. Dr. William Cox has noted an additional feature occurring in some of these crushing fractures of the body, namely a tendency of the major posterior fragment to rotate clockwise. The posterior articular surface attached to this segment is thus rotated forward and downward presenting in an almost vertical position in the lateral view.

The fractures are of the same appearance, whether the force is delivered from above or from below. However, the extreme degree of comminution and frequent bilateral incidence is rather typical of those produced by the reversed mechanism.

DIAGNOSIS

One obtains a history of a fall, the injured one landing feet first, or of being injured as a result of an explosion from below deck with a sudden upward thrust exerted by the deck on which the patient was standing. Usually the patient is unable to bear weight on the affected limb, with pain being referred to the region of the heel. Examination reveals a local swelling and tenderness, and occasionally abnormal mobility may be elicited. The heel may appear elevated and shortened. Subastragalar motions are found to be painful and limited.

A complete x-ray examination of the os calcis requires several views. These views are:

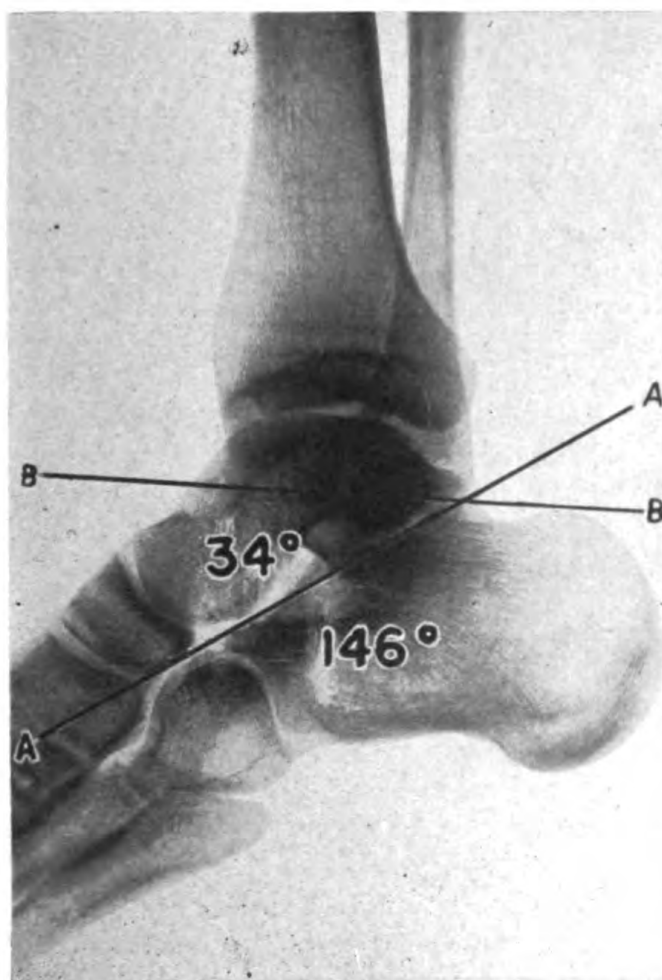
1. The lateral. This shows the relationship between the os calcis and the tarsal bones that it articulates with, and from it can be measured the tuber angle.
2. The plantar view of the foot. This view shows any disturbance in appearance or position of the anterior portion of the os calcis.

3. The oblique view. This view shows especially well the relationship between the os calcis and the talus and cuboid, particularly the anterior superior tip.

4. The tangential view. This view is a plantar view of the os calcis. There are several ways to obtain this view depending on the comfort of the patient:

- (a) The foot can be placed flat on the film and the ray directed downward from behind the foot.
- (b) The patient can be supine, the film behind the ankle, and the ray directed downward through the heel from the plantar side.
- (c) The patient can be prone, the film held against the sole of the foot and the ray directed from behind the ankle through the os calcis.

Where accurate measurements are wanted, both feet and all views should be taken for comparison. One determines the degree of anterior-posterior displacement by drawing two lines on the film with a ruler; the first line uniting the posterior superior tubercle of the



1. LATERAL VIEW OF NORMAL FOOT. LINES PROJECT NORMAL ANGLES. LINE A-A FROM ANTERIOR SUPERIOR TIP OF OS CALCIS TO THE POSTERIOR ARTICULAR MARGIN. B-B FROM THE POSTERIOR SUPERIOR TUBERCLE OF THE OS CALCIS TO THE POSTERIOR TIP OF THE ARTICULAR FACET.

os calcis and the posterior tip of the articular facet. The second from the anterior superior tip of the os calcis to the posterior articular margin. Normally these lines cross, and the degree of angle created registers the oblique axis of the posterior heel process. In case of fracture with any marked degree of deformity, the lines may fail to cross and instead be relatively parallel. Measurements taken on the good foot will indicate what the degree of angulation in the affected foot should be. These measurements remain fairly constant in a series of normal individuals. Most normal measurements will range between 140° to 150° , and the outside supplemental angle will therefore obviously range from 40° to 30° (fig. 1). The x-ray will also reveal the degree of outward displacement and deviation. The amount of articular irregularity, depression or rotation should be carefully noted as well as any abnormal bony prominence on the plantar surface.

THERAPY

The management of this fracture lends itself rather ideally to war-time emergency conditions. Böhler in the late twenties recommended a well-outlined program for os calcis fractures. In general, his procedures are followed by most men treating these fractures today. Before discussing Böhler's therapy, let us consider the objectives one wishes to obtain and the resulting types of disability if these objectives are not attained. The restoration of the normal tuber angle is one of the chief objects in reduction. Failure to correct the existing deformity and displacement only too often gives rise to several types of disability. Flattening and outward deviation distend the weight bearing mechanism with resulting pronation or flattening of the longitudinal arch. As a result, symptoms of weakness and strain are retained. Any existing outward displacement may lead to bony impingement against the lateral malleolus causing pain and limitation of motion. The fracture may also produce so much irregularity of the superior articular facets as to limit function and cause chronic synovitis. This condition often produces pain on weight bearing. The comminution and displacement may give rise to abnormal bony prominences on the plantar surface which may become painful pressure points. Unfortunately, not infrequently, it is impossible to achieve a perfect reduction.

The goal of active therapy is to overcome, if possible, the above-mentioned causes of continued disability. The immediate wound excision or debridement of those compounded has been mentioned. With this exception it is advantageous to elevate and immobilize in plaster for approximately 1 week. After this interval the soft tissue swelling has subsided and the foot is ready for active molding and correcting of existing deformity. By applying an early cast, skin

blebs are less likely to develop. A Kirschner wire or preferably Steinmann pin is inserted through the superior-posterior portion of the posterior process of the os calcis, with the foot in acute dorsiflexion at time of insertion. In so doing the skin is less likely to develop a pressure area adjacent to the pin. With this as a means for skeletal traction the leg is suspended in a Böhler frame or some other improvised suspension apparatus. Thirty to forty pounds traction is applied in a horizontal axis to overcome the upward displacement. The line of traction is then altered so that it will bisect the 90° angle formed by the longitudinal axis of the calf and the plantar surface of the foot. This helps to overcome the foreshortening as well as the upward displacement. The lower portion of the extremity is held suspended by a second pin or wire placed through the posterior aspect of the tibia 3 to 4 fingers' breadth above the internal malleolus.

The excessive widening created by the upward mushrooming of the fracture is now molded by means of the Böhler redresser. The normal ankle may be used as a control. The underlying skin should be protected by a thin strip of felt and the squeezing action applied and held only momentarily. With the pins left in place the foot and calf are encased in a molded plaster with the foot in a slightly equinus position to ease the pull of the gastrocnemius muscle. The foot and ankle should be examined to determine whether the external contour of the foot and the weight-bearing alignment are satisfactory. Any tendency toward valgus deformity should be corrected if possible, the arch of the foot should be symmetrical and the weight-bearing line should be through the center of the astragalus.

Should the crushing fracture of the body be one with additional clockwise rotation of the major posterior fragment, Cox has suggested the following manipulation in addition to Böhler's reduction maneuvers. By inserting a screw type of pin into the posterior fragment from the back of the foot it is manipulated anticlockwise until the superior posterior articular surface of the os calcis is brought into proper alignment. The pin is then screwed into the anterior fragment or fragments. Only the foot is encased in plaster with posterior pin left in place. The other two pins may be removed. Early active motion in the ankle and subastragalar joints would seem advisable in those fractures with much articular damage. This may be accomplished by the use of the posteriorly placed pin if the comminution of the major fragments is not too great and the normal tuber angle can be maintained by it. Fixation with pins should be maintained from 8 to 10 weeks with no weight bearing. After the pins are removed a well-molded plaster cast should be applied. It may be safe at the time to add a walking iron but it must be remembered that we are dealing with a very cancellous bone. Plaster should be continued

for a total of 16 weeks. If manipulation fails to reduce the duck-bill type of posterior avulsion fracture and the isolated fracture of the sustentaculum, open reduction and internal fixation is recommended. Fissure fractures ordinarily require no manipulation. Immobilizing with or without plaster will suffice. One should be hesitant in recommending early weight-bearing. It is understandable that, because of the character of the bone and the frequent extreme degree of comminution one is unable to achieve always as complete a reduction as in the case of other skeletal fractures. This is particularly true with restoration of the superior articular surface of the os calcis. If this remains irregular many will complain of late pain after the fracture has healed. Weight bearing causes an increase in pain which is the result of a chronic synovitis. Any derangement not only of the subastragalar joint, but also of the reciprocal articulations of the os calcis may be cause for continued pain on weight-bearing. Because of this combination of factors triple arthrodesis has been recommended by some authors as early as 5 to 6 weeks after manipulation in all badly comminuted or "squash" type fractures. Existing plantar spurs or bony irregularities may be removed sometime after the pins have been taken out.

CONCLUSION

1. The wartime incidence of these fractures in naval personnel will be greatly increased.
2. The ordinary and the reversed type mechanism have been described.
3. The usual types of fractures and methods of treatment have been described in some detail.
4. The very slow healing of these fractures should be borne in mind, and, as a rule, plaster support should not be discontinued before 14 to 16 weeks. Early weight bearing should not be allowed, but early active motion of the ankle joint when feasible should be encouraged.
5. Because of the high incidence of permanent disability, it was thought highly desirable to emphasize the advisability of more careful attempts at reduction.
6. The technic as outlined lends itself rather well to emergency conditions; active manipulative therapy is postponed to advantage for 7 to 10 days.
7. It is hoped that by more careful attempts at reduction, the number and the degree of late arthrodeses in our young naval age group will be materially reduced.

NOTE.—The writer wishes to acknowledge the helpful suggestions of Dr. E. Leef regarding x-ray technic; and also Dr. W. Cox, whose work on this subject has not as yet been published.

THE TREATMENT OF FRACTURES OF THE TIBIA ON BOARD SHIP¹

By RICHARD S. SILVIS, Lieutenant Commander, Medical Corps, United States Navy

The purpose of this article is to make available to medical officers a mechanical draftsman's sketch of the Böhler reduction frame, and a detailed description of its use. With this sketch any competent metalsmith can manufacture the apparatus on board ship. This reduction frame was designed and originally used by Dr. Lorenz Böhler,² of Vienna, in the reduction of fractures of the tibia and os calcis.

The shaft of the tibia is one of the most common sites of major fractures on board ship. In these cases the fibula is almost always fractured also; but since these associated fibular fractures are of slight clinical importance, the fibula will not be mentioned in this text. If the fracture of the tibia is properly reduced, the operator may usually disregard the fibula, since it generally falls into satisfactory position and alinement, and tends to unite all too soon in many cases.

With early reduction and adequate fixation, the vast majority of fractures of the shaft of the tibia unite without complication. Fixation by traction is not satisfactory, since movement of the ship results in movement of the fragments, with consequent pain to the patient, and delayed or nonunion of the fracture. Fixation by plaster alone is unsatisfactory in that it will not prevent over-riding of the fragments. Due to the exigencies of war, 2 to 8 weeks may elapse before the patient is transferred to the hospital. If fixation is not maintained during this interval a case of nonunion, with partial occlusion of the medullary canals, has been produced. A comparatively simple case has been converted into a difficult problem necessitating many months of treatment, and possibly resulting in a permanent disability.

Fractures of the shaft of the tibia are compound more often than fractures at any other site. It is doubly important to maintain adequate fixation in the case of a compound fracture. With the advantages of the sulfonamides, most of the compound fractures will heal without the dreaded complication of osteomyelitis, provided the fragments are held stationary. Inadequate fixation will result in a marked increase in the incidence of osteomyelitis in compound fractures, as well as having a deleterious effect upon the general condition of the patient.

¹ Received for publication September 10, 1942.

² Böhler, Lorenz: *Treatment of Fractures*, fourth edition. Pp. 409-418. The Williams & Wilkins Co., Baltimore, Md., 1935.

Satisfactory immobilization of a fracture of the shaft of the tibia for a considerable time on board ship may best be obtained by the insertion of two or three Steinmann pins through the tibia, and the incorporation of these pins in a plaster cast. The simplest method of reduction and fixation during the application of the plaster cast is that of Böhler. Previous experience with the Böhler reduction frame is not mandatory, since the reduction of the majority of fractures with this apparatus is spontaneous. In other words, the fracture often "sets itself" without manipulation. Orthopedic specialists would undoubtedly achieve more accurate reduction in a large series of cases with the Roger Anderson apparatus, the Stader reduction splint, or other devices which depend upon pure mechanics for the accurate reduction of fractures. These devices are not practical on board ship however, for they necessitate the use of a fluoroscope and special training.

ANESTHESIA

Spinal anesthesia is preferable. The patient is placed on the operating table in the supine position. An assistant stationed at the foot of the table grasps the patient's hands, raises him into a sitting position, and holds him steady during the procedure. The fourth lumbar interspace is the preferred site of injection. One hundred milligrams of novocaine is sufficient for the reduction of a simple fracture, whereas 150 milligrams should be used in the case of a compound fracture.

TECHNIC OF REDUCTION

1. The skin over the areas of insertion of the pins is shaved, cleansed thoroughly with soap and ether, and painted with tincture of merthiolate. The remainder of the leg is not shaved. The prepared areas are draped.

2. The Steinmann pins are inserted. The upper pin is inserted at the level of the lower margin of the anterior tibial tubercle, two centimeters posterior to the anterior surface of the skin. The lower pin is inserted through the center of the tibia one fingerbreadth above the superior margin of the medial malleolus.

A modification of this technic is necessary if the fracture is so close to an end of the tibia as to preclude the insertion of a pin through that end. If the fracture is near the proximal end of the tibia, the pin should be placed through the distal end of the femur, and a full length cast including the thigh should be applied, after the Böhler frame is removed. This pin should be placed through the center of the femur, one finger breadth above the proximal margin of the lateral epicondyle. If the fracture is near the distal end of the tibia, the pin should be placed through the os calcis, instead of the Kirschner wire, and should be allowed to remain *in situ* for permanent fixation.

The Steinmann pins may be from 4 to 6 millimeters in diameter. They may be easily manufactured on board ship from stainless steel stock. They are best inserted with a small hand wrench or awl. Once started, a large carpenter's brace may be used to complete their insertion, but if a brace is used to start a pin the point may slip and injure a nerve or blood vessel. Driving the pins with a hammer is more likely to cause splitting of the tibia than drilling them through.

If possible it is always desirable to insert a third pin. Since the fracture is rarely located at the exact center of the tibia, a second pin may be placed through the longer fragment, taking care to place it at a safe distance from the site of the fracture. It should be placed at a different angle than the other pin in the same fragment. This third pin will aid in preventing anterior posterior movement of the fragments. It should be smaller in diameter than the pins at the ends of the tibia.

3. A Kirschner wire is now placed through the os calcis, two finger breadths posterior and two finger breadths distal to the external malleolus. If a Kirschner wire apparatus is not available a small Steinmann pin, or traction tongs, may be used. Since this arrangement is temporary, to be used for traction during the reduction and fixation only, a Kirschner wire is preferable because it causes less trauma.

4. The Kirschner wire extension apparatus is applied. While maintaining manual traction on the Kirschner apparatus, the leg is raised and placed on the Böhler reduction frame, with the hip and knee joints each flexed 90°. The proximal portion of the frame is shoved tightly against the patient's buttock. The crossbar (see upper right corner figure 1) is adjusted so as to fit the thigh as close to the knee as possible. An evenly folded pad is placed in the popliteal space. The spring scale is attached to the Kirschner extension apparatus, and the screw is gradually tightened so that 40 pounds of traction is applied. This initial traction may be varied from 35 to 50 pounds, depending upon the size and muscularity of the individual.

5. The operator should now be patient, and not attempt immediate manipulation. After the few minutes of traction necessary to correct the shortening, the other elements of displacement, angulation, rotation, and malposition generally disappear spontaneously. The fracture site is then palpated, and if reduction is not complete, manipulation and the application of pressure over the displaced fragments will usually result in satisfactory reduction. The edema which is usually present may now be dispersed by gentle pressure massage.

The operator should bear certain fundamentals in mind, namely, that good alinement is more important than anatomic apposition of the fragments; and that if alinement is not perfect anterior bowing

or an inversion deformity (bowleg) results in a good functional leg, whereas posterior bowing or an eversion deformity produces a disturbance of weight bearing and a poor functional result.

6. When reduction has been accomplished, the traction should be decreased to half of the initial pull (18 to 25 pounds) prior to the application of the plaster cast. If possible, the x-ray should now be used to check the position and alinement of the fragments before the plaster is applied. The traction should be maintained until the plaster cast is thoroughly dry.

APPLICATION OF THE PLASTER CAST

1. No padding should be used unless lacerations exist.
2. Corks are placed over the ends of the Steinmann pins to prevent injury to the operator or his assistants.
3. A felt band 1-inch wide is taped snugly around the leg at the level of the upper margin of the anterior tibial tubercle.
4. The distance is measured from the upper margin of the felt pad, down the side of the leg, around the foot, and up to the felt pad on the opposite side with a piece of gauze. A plaster splint 2.5 inches wide and 2 inches longer than the piece of gauze is now prepared. The plaster should be very wet. It is placed down one side of the leg, slits are cut in its anterior margin to fit around the pins, it is taken across the foot and up the opposite side in like manner, and is then bound in place with a roller gauze bandage. In applying this splint it is important to allow a slight excess of length between the pins, so that the margins in contact with the pins curl slightly outward, thus providing more plaster surface against the pins.
5. When the plaster is sufficiently dry to retain its shape, the roller bandage is removed, and a posterior splint is applied from the felt band to one inch beyond the great toe. This splint should be very wet and should be wide enough to overlap the lateral splint liberally on each side. It should be applied when the lateral splint is moist, so as to permit plaster union to occur between the two.

The splint is applied from above, being fixed in place during its application with a roller gauze bandage. Its distal corners are held straight by an assistant, transverse cuts are made at the level of the inferior margin of the heel, and the lateral margins of the splint are molded to the sides of the heel. The foot should be held at right angles to the leg by an assistant during the application and drying of the cast. The distal end of the splint is then molded over the plantar surface and sides of the foot. The cast should be molded rather loosely over the dorsum of the heel to allow for the retraction of the heel which occurs when the Kirschner wire and traction are removed.

At the distal end of the splint, its margins, which have been molded to the sides of the foot, will form right angles with the central portion of the splint. This angle-iron arrangement should be left intact to preserve the strength of the projecting inch of the plaster cast, which is necessary to keep the weight of the sheet and blanket from the patient's toes.

6. When the plaster has set sufficiently to hold its position, but is still moist, the gauze bandage is removed, and the cast is completed with roller plaster bandages. Care should be taken to fit this bandage loosely over the instep. It is important that the cast extend over the dorsum of the foot to the base of the toes, for if it should terminate short of this point, troublesome edema of the dorsum of the foot immediately proximal to the toes will develop.

7. The corks are now removed from the ends of the Steinmann pins, which are covered lightly with gauze, and then incorporated in plaster. This procedure will prevent rotation of the pins, and will also eliminate tearing of the bedclothes by their sharp ends.

8. After the plaster has dried, the leg is removed from the Böhler reduction frame, the Kirschner wire is removed, and the small resulting holes in the cast are filled with plaster.

9. The patient is placed in bed and the leg is put up on a Braun frame, or on two pillows. The foot is held at right angles to the leg by the plaster cast, thus eliminating any danger of foot drop.

COMPOUND FRACTURES

In the reduction of a compound fracture of the tibia the steps heretofore outlined should be followed in their exact sequence. The additional treatment incident to the compound wound should be interspersed as follows:

1. After the sites for the insertion of the pins have been prepared, the skin surrounding the wound should be carefully shaved by the operator himself, cleansed, and painted with tincture of merthiolate. During this procedure extreme care should be taken to prevent further contamination of the wound. It is best to delay the administration of the spinal anesthetic until after the skin has been prepared, for this is often a time consuming procedure.

2. After the Steinmann pins and Kirschner wire have been inserted the wound is flushed with one to three quarts of warm normal saline, draped, and a partial debridement is performed. The skin margins may be debrided at this stage. Any sharp projecting spicule of bone that is grossly contaminated should be excised now, since it would retract into the wound when traction is applied.

3. After the reduction frame and traction have been applied the debridement is completed. The wound is flushed with additional normal saline. No antiseptics are placed in the wound.

4. Reduction is now completed, and sutures are placed but are not tied. It is not advisable to use buried sutures. Sutures of heavy silk or cotton are preferable.

5. Sulfanilamide powder (or microcrystalline sulfathiazole) is now sprinkled liberally into the wound, and the sutures are tied, closing the laceration without drainage.

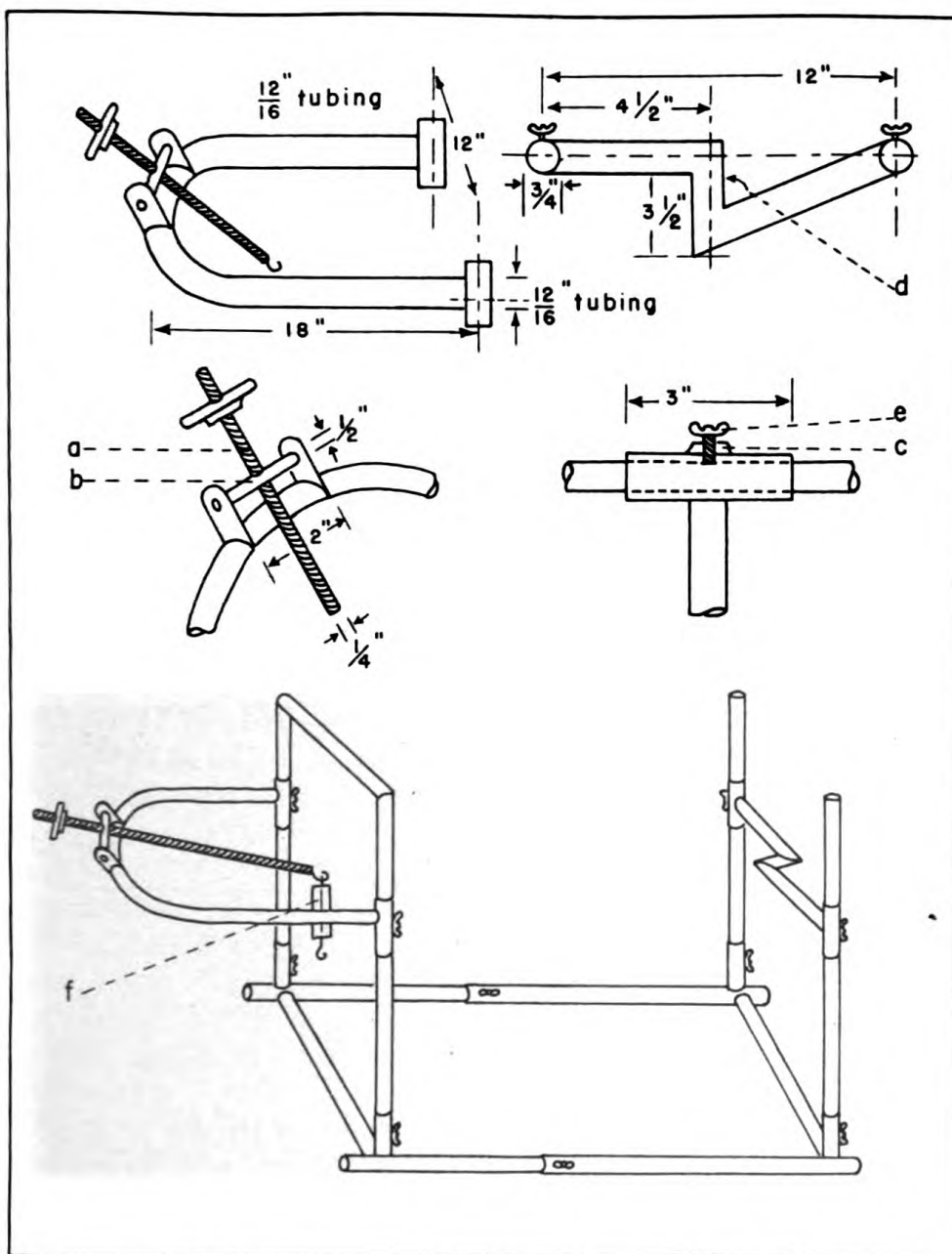
Primary closure cannot be performed in the case of certain compound wounds because of their size, extreme contamination, or delay in operation, but the vast majority may be closed with impunity. Primary closure results in a marked decrease in the incidence of osteomyelitis, and should be performed whenever possible. The operator should not hesitate to convert a round laceration into a linear elliptical one to permit accurate closure. If the margins of the wound cannot be brought together, or if their apposition creates too much tension, a long curved relaxing incision (with its concavity anterior) should be made on the lateral surface of the leg. The incision should be about 3 centimeters lateral to the laceration, and should extend 5 to 8 centimeters beyond it both above and below. A thick flap should be dissected free medially from the relaxing incision, care being taken not to extend the dissection into the compound wound. If necessary, relaxing incisions may be made on both sides of the leg. The resulting defects are only 1 or 2 centimeters wide, and they generally granulate readily. They do not communicate with the compound wound and the bone is completely covered, which is the primary consideration.

6. A dry sterile gauze dressing and three layers of padding are applied over the closed laceration. If relaxing incisions have been made they are covered with sterile vaseline gauze and padding.

7. The plaster cast is applied exactly as heretofore outlined, completely incorporating the leg in a circular cast. Providing that the patient does not become septic, and the circulation to his toes remains adequate, this cast should not be tampered with. The cutting of windows to inspect the compound wound is to be condemned, for it not only provides additional chance for infection, but invariably results in edema of the leg over the site of the window.

8. In the usual case, the pins are removed in 4 to 6 weeks, and the cast is removed in 8 to 10 weeks.

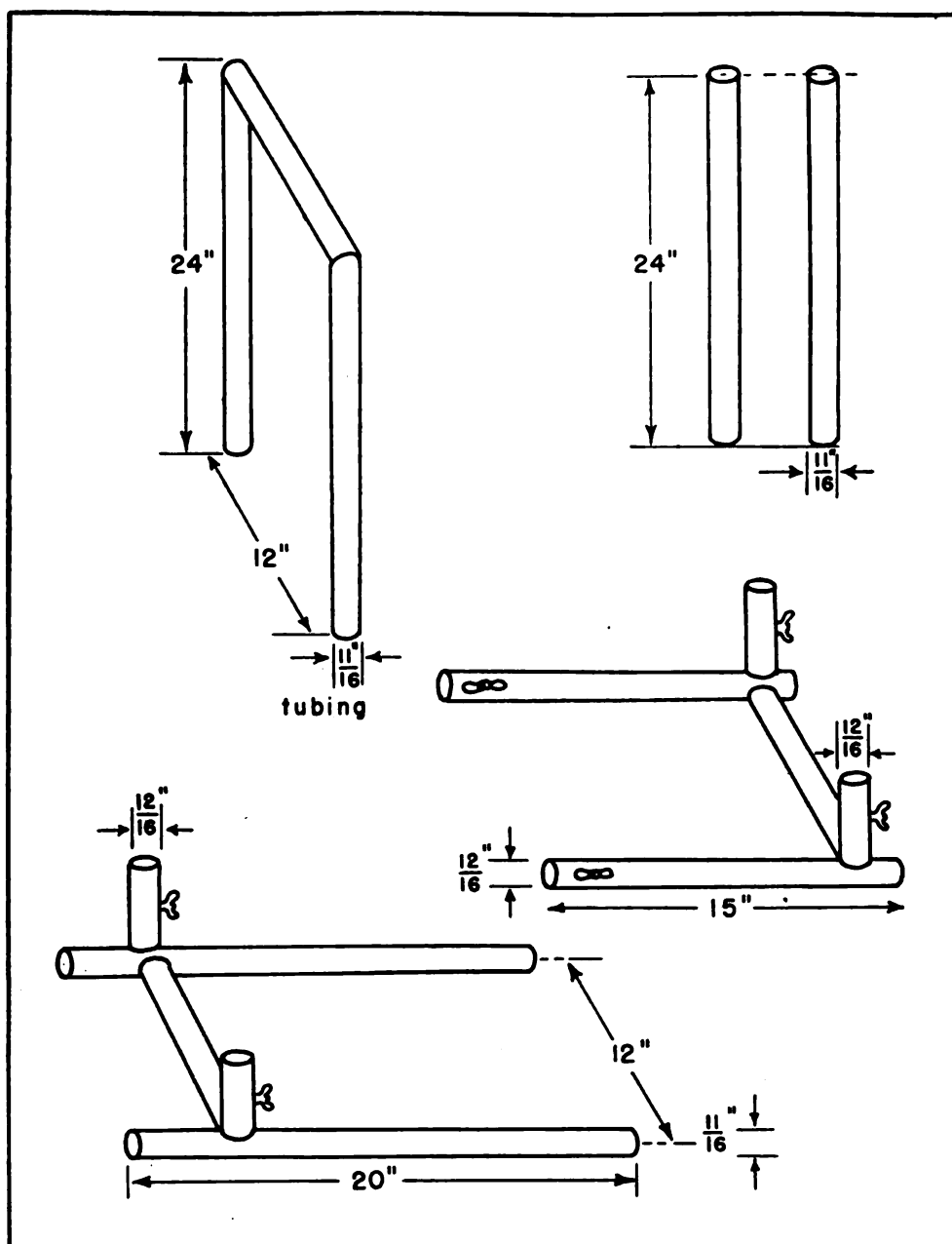
The procedures described were used at the United States Naval Hospital, San Diego, Calif., in a series of 25 cases of fracture of the shaft of the tibia in 1941 with excellent results. At the risk of being academic, all of the small detailed practical points in the description of the technic have been included, for not infrequently the omission of a small detail will result in an unsatisfactory cast.



1. THE BÖHLER REDUCTION FRAME. *a*, $\frac{1}{2}$ -INCH ROD, 16 INCHES LONG WITH HOOK AT END, TO BE THREADED ITS FULL LENGTH. *b*, $\frac{1}{2}$ -INCH TUBE, TO ROLL, SO THAT HOOK CAN BE ADJUSTED TO ANY DESIRED ANGLE. *c*, ALL BOSSES TO BE WELDED AND TAPPED FOR $\frac{1}{2}$ -INCH BOLT WITH WING NUT. *d*, THIS ANGLE TO BE 70° . *e*, $\frac{1}{2}$ -INCH BOLT WITH WING NUT. *f*, SPRING SCALE, 50 POUNDS CAPACITY. ALL JOINTS TO BE WELDED. (ADAPTED FROM BÖHLER.)

SUMMARY

A sketch of the Böhler reduction frame, to permit its construction on board ship, and a detailed description of its use in the reduction and fixation of fractures of the shaft of the tibia is presented. It is



2. THE BÖHLER REDUCTION FRAME (DETAIL) FEATURES. FRAME MAY BE TAKEN APART AND STOWED IN SMALL SPACE. ADJUSTMENTS ENABLE OPERATOR TO FIT FRAME ACCURATELY TO ANY LEG. SINCE THE TENDONS OF THE MEDIAL HAMSTRINGS ARE POSTERIOR TO THE TENDONS OF THE LATERAL HAMSTRINGS THE CROSSBAR PICTURED IN THE UPPER RIGHT-HAND CORNER OF FIGURE 1 IS ANGLED SO AS TO FIT ACCURATELY. IT MAY BE REVERSED FOR USE ON THE OPPOSITE LEG. (ADAPTED FROM BÖHLER.)

believed that this is the most practical method of securing satisfactory reduction and immobilization of these fractures for a period of weeks on board ship.

AN EXPERIMENTAL STUDY OF UNDERWATER CONCUSSION¹

By **FREDERICK C. GREAVES**, Captain, Medical Corps, United States Navy; **RUPERT H. DRAEGER**, Commander, Medical Corps, United States Navy; **OSBORNE A. BRINES**, Commander, Medical Corps, United States Naval Reserve; **JOHN S. SHAVER**, Lieutenant, Medical Corps, United States Navy; and **EDWARD L. CONEY**, Lieutenant, H-V (S), United States Naval Reserve.

The production of blast injuries by high explosive in the present war has presented the medical world with a hitherto partially recognized and inadequately studied problem. Pure blast injuries without visible external wounds were reported during and immediately following the last war but the subject was not thoroughly investigated and was soon pushed into the background by current medical problems. One investigator, Hooker, in 1924 (1) studied the effects of gun blast upon animals and concluded that pulmonary tissue was particularly susceptible to injury. Interest in the subject then lapsed until the Spanish civil war when blast casualties were again encountered and were the subject of articles by Haldane (2) and Kretzschmar (3). The indiscriminate bombing of British cities in 1940 marks the beginning of an earnest and detailed study of the subject.

The most comprehensive report is that of Zuckerman (4). He studied the effects of blast upon small animals and confirmed Hooker's observations that the lungs bear the brunt of the damage. He reviewed three theories used to explain the production of the injuries and rejected the first two. The first theory was that the suction phase of the blast wave, operating through the air passages, reduced the pressure within the alveolar spaces sufficiently to rupture the alveolar capillaries. The second was that damage of the alveolar walls was caused by distention of the lungs with air. The third theory, and the one to which he subscribed, was that the impact of the compression wave upon the chest forcibly compressed the body walls while at the same time expulsion of the air from the lungs was interfered with by the sudden elevation of pressure within the trachea. In addition to Zuckerman's work there have appeared several reports upon the clinical aspects of blast victims. All emphasize the importance and the prevalence of lung damage and a few mention the possibility of injury to the abdominal viscera and to the central nervous system.

The first reports of water-borne blast injuries appeared in an article by Atkins (5) in which he spoke of this type of casualty among the men evacuated from Dunkirk. Early in 1942 an article by Breden, d'Abreu, and King reported upon the clinical histories of ten victims

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of water blast induced by torpedo and depth charge explosions. All presented symptoms of abdominal pathology. Seven recovered without operation. Three were operated upon for peritonitis and one of these died. The autopsy showed a perforation of the small intestine with generalized peritonitis and numerous submucous hemorrhages in various parts of the gastro-intestinal tract. The authors were of the opinion that abdominal viscera were more susceptible to injury in underwater blast than lungs and that the lungs might well escape injury entirely. No statement was made of the exact circumstances in which the injuries were received nor whether the men were wearing life jackets when they were injured.

The present report is based upon data obtained from observing the effects of underwater concussion on animals. Rats, guinea pigs and goats were used. Rats and guinea pigs were exposed to explosions of tetryl (dinitrophenylmethylnitramine) which is similar to TNT in explosive force but is more sensitive to detonation in small quantities. A welded steel tank 70 by 48 by 42 inches was sunk in the ground and filled with fresh water. The charge was detonated 20 inches below the surface while the animals were swimming within a 2-foot circle around a point directly over the charge. The goats were exposed to the effects of a 300-pound depth charge, exploded 50 feet below the surface in water 100 feet in depth.

PROCEDURE

The amount of explosive necessary to produce death of the animals in approximately 1 minute was determined in order that the lesions could be studied and classified. This was found to be 5 grams of tetryl for adult white rats and 6 grams for adult guinea pigs under conditions described above for studies carried out in the tank. When this was determined charges were diminished to produce sublethal and minimal lesions. No attempt was made to take and record pressure gage readings. The pressures developed were computed from data furnished by the Bureau of Ordnance. The physical characteristics of underwater blast waves renders the problem of pressure computation relatively simple when compared to computing the pressures of air-borne blast waves. That part of the study involving goats was carried out at sea where conditions approaching actual depth charge explosions were simulated.

OBSERVATIONS

When death occurred immediately following the blast it was due to pulmonary damage. The respiratory function of the lungs was immediately and totally destroyed. The animals were not rendered unconscious by the blast but struggled in the water and continued their

swimming motions for several seconds. Cyanosis appeared and the nose and mouth exuded a bloody, frothy liquid. Death occurred in about 1 minute. When sublethal charges were used the animals continued to swim, but upon being removed from the water remained quiet and appeared ill. Occasionally bloody froth was present about the nares and the respirations were shallow and rapid. Some of these animals died after a few hours. Those that survived regained their normal actions within a short time and demonstrated no ill effects thereafter. Animals receiving minimal injuries remained quiet for 10 to 15 minutes after the blast after which they appeared normal and showed no further ill effects.

GROSS PATHOLOGY

The uniformity of lesions produced under comparable conditions in all animals was quite remarkable. Gross lesions may be divided into three groups, according to degree of severity:

1. Those produced by lethal charges.
2. Those produced by sublethal charges.
3. Minimal lesions.

The first group consisted of the lesions that produced death within 1 minute. In the lungs they were characterized by diffuse hemorrhage throughout the entire parenchyma. Very little aerated pulmonary tissue remained. Free and clotted blood was found in the air passages and, in occasional animals, lacerations of the visceral pleura with secondary hemothorax was seen. Subpleural hematomas were also encountered and in some of these small air blebs were seen. The hemorrhagic discoloration of the lungs was not uniform but was more marked in some areas than in others. The outlines of ribs and intercostal spaces upon the pleural surfaces were prominent in the lungs of goats and appeared as alternating dark and light areas of discoloration. The darker areas, representing the greater damage, corresponded to the interspaces rather than the ribs. This is readily ascertained in the goat due to the relative narrowness of the ribs in comparison with the wider intercostal spaces. This observation is contrary to the views held by some clinical observers who have stated that the ribs are driven into the lungs when the chest wall is compressed by the blast wave, thus producing more injury than the soft tissue interspaces.

In the gastro-intestinal tract two types of lesions were seen in lethal cases. They were complete perforation of the wall and hemorrhagic discolorations of the wall. No lesions were seen in the mesenteric attachment. Both types were seen in all portions of the gastro-intestinal tract from stomach to rectum and both were definitely related to the presence of gas within the lumen. This was strikingly

borne out by hemorrhagic lesions in the fundus pouch of the guinea-pig stomach which usually contains a bubble of gas, and in the cecums and lower ileums which also frequently contain gas. Perforating lesions were usually associated with little interstitial hemorrhage and no hemorrhage into the lumen, thus giving the lesion the appearance of a sudden disruption of the wall from within outward.

Not all the animals receiving fatal blast injuries showed intestinal lesions. The presence of gas appeared to be the determining factor in their production and they were never noted when the gastro-intestinal tract was collapsed and empty. Goats are not satisfactory animals for study of intestinal lesions due to the anatomical arrangement of the gastro-intestinal tract. The large, thick walled ruminant stomach acts as a protective apron for the underlying intestinal coils. Three out of five of these animals killed by the blast showed perforating lesions of the first stomach just above its junction with the ruminant stomach.

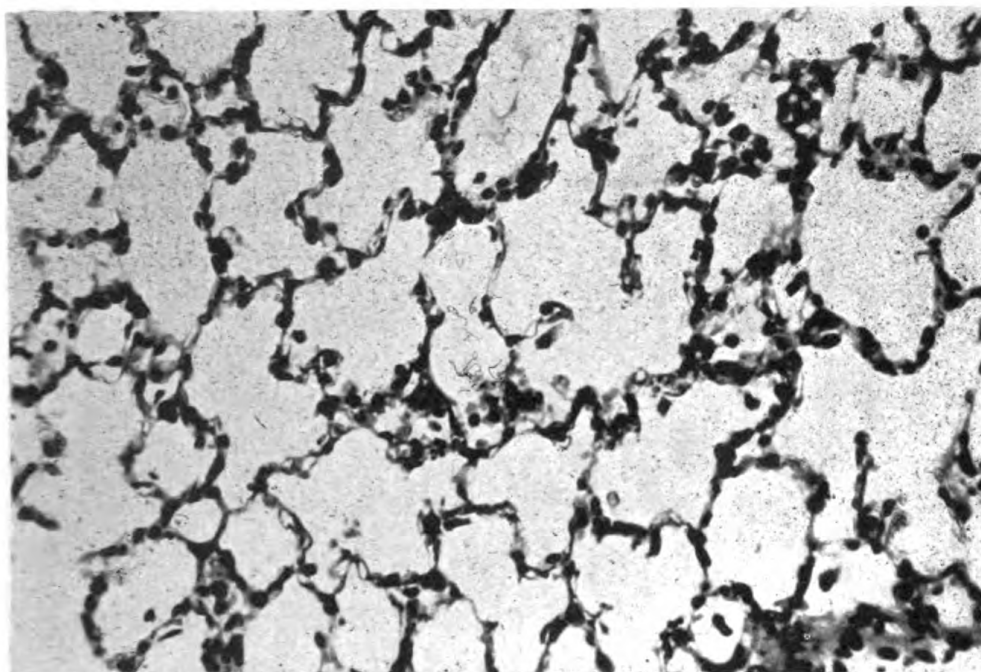
In the second group, sublethal charges produced similar but less extensive damage. Areas of pulmonary hemorrhage were more localized. Pleural laceration was not seen and bleeding into the air passages was less frequent and less severe. Gastro-intestinal lesions were fewer and also smaller in size.

Minimal lesions in the lungs were small in size and few in number. They were frequently symmetrical and marginal, involving the antero-inferior edges or lingulae pulmonis. Intestinal lesions were limited to an occasional hemorrhagic area usually located in the cecum or colon.

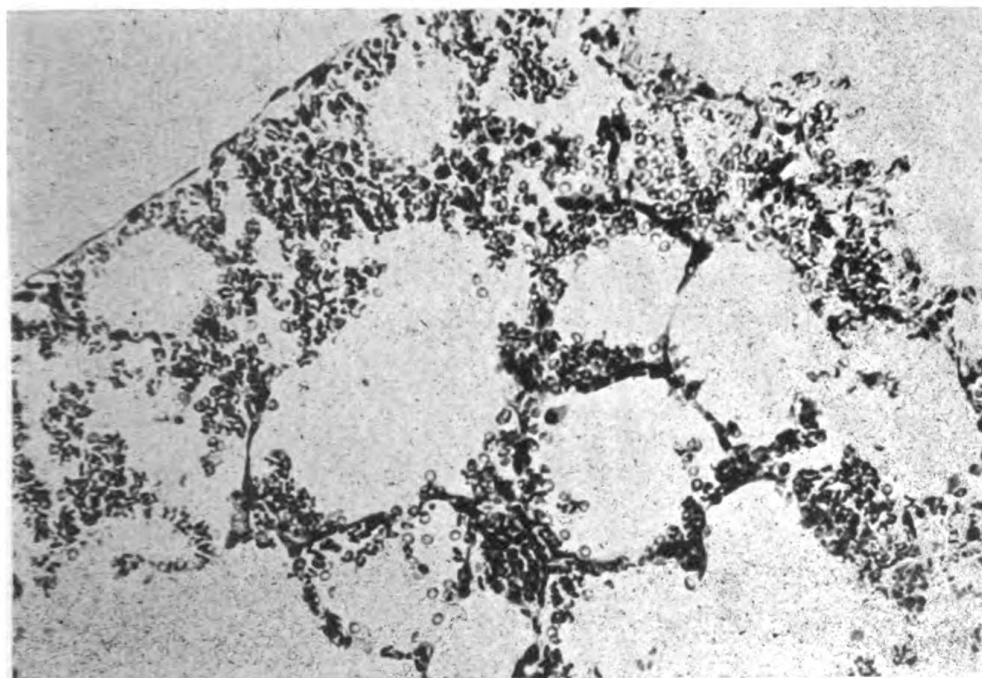
In summarizing the gross lesions it may be stated that pulmonary lesions were always found if any injuries resulted from the blast, but that intestinal lesions were quite inconstant in occurrence. None of the other organs or tissues in the thorax or abdomen showed injury. No brain or central nervous system lesions were encountered. A few fractured extremities resulted from high-order explosions.

MICROSCOPIC PATHOLOGY

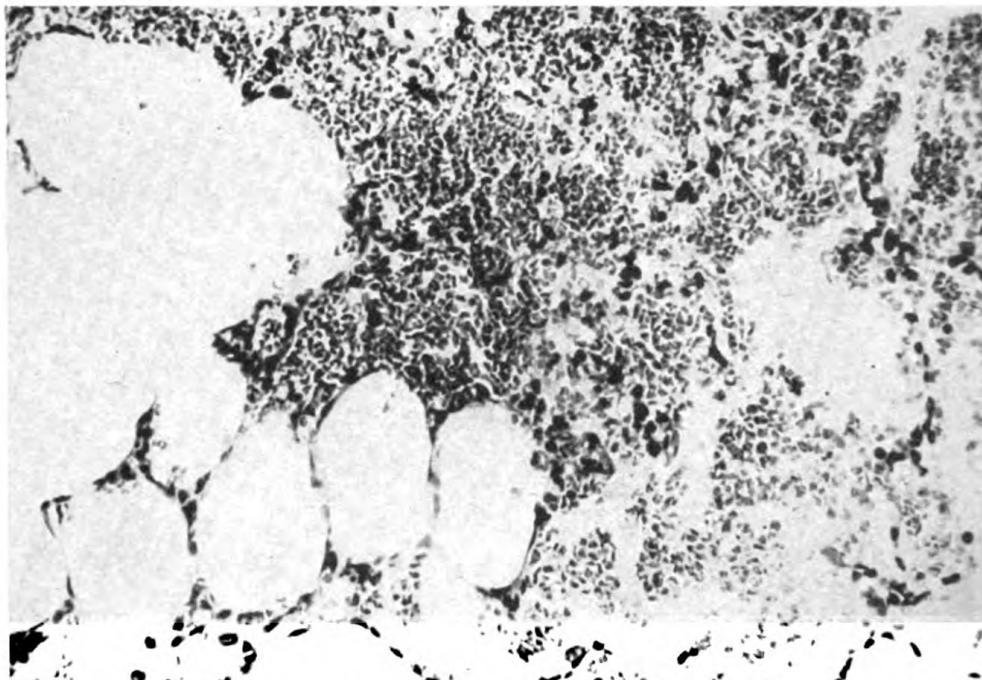
The histopathology of the pulmonary lesions was best studied in the minimal injuries. The functional and anatomical unit of the lung is the tissue lying distal to the end of the terminal bronchiole. This consists of the atrium with its pulmonary alveoli and alveolar sacs. The walls of these structures are formed by a few delicate fibers of elastic tissue which make up the framework supporting the capillary bed and the flat respiratory epithelial cells lining the air spaces. The capillary network in the walls of these structures is the most extensive in the body. It is so dense that spaces between vessels are frequently smaller than the diameters of the vessels themselves. In minimal



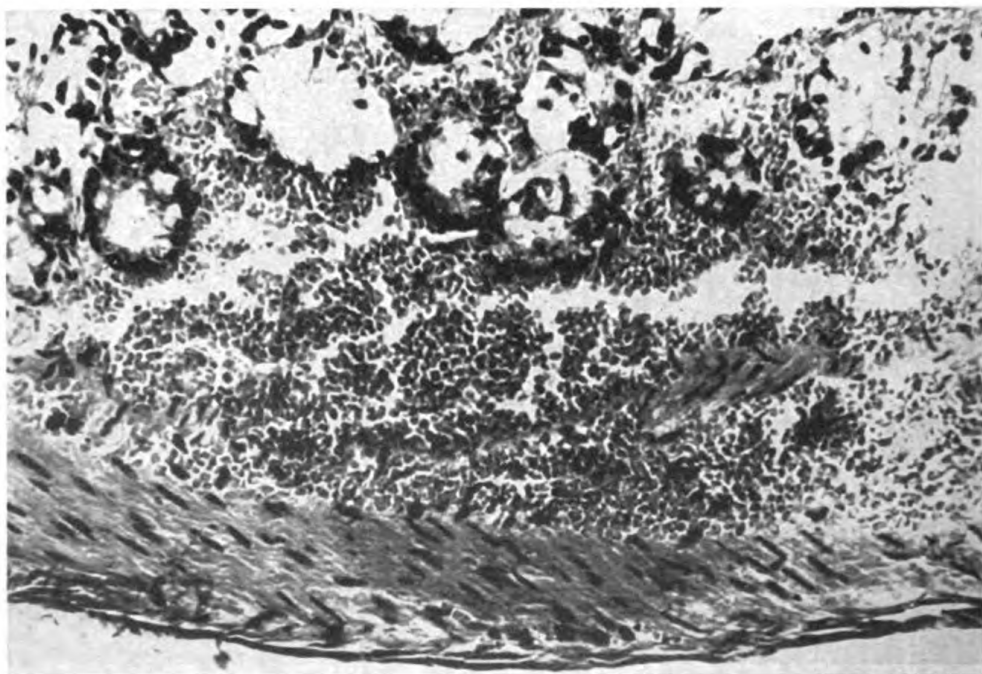
1. A NORMAL GUINEA PIG LUNG (X 400). CAPILLARIES INJECTED WITH INDIA INK. THE DELICATE STRUCTURE OF THE ALVEOLAR WALLS IS DEMONSTRATED



2. GUINEA PIG LUNG (X 400). MINIMAL LESION SHOWING INTERSTITIAL HEMORRHAGE AND COLLECTION OF BLOOD CELLS WITHIN THE ALVEOLAR SPACES WITHOUT SERIOUS DISRUPTION OF THE ALVEOLAR SEPTA.



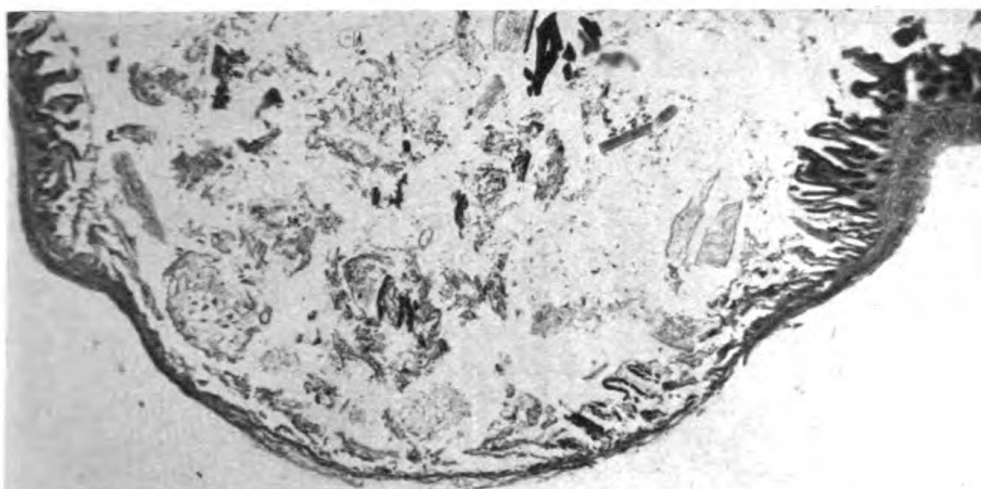
3. GUINEA PIG LUNG (X 400). A LETHAL PULMONARY LESION SHOWING DISRUPTION OF THE ALVEOLAR SEPTA, GROSS HEMORRHAGE AND TRAUMATIC EMPHYSEMA.



4. GUINEA PIG COLON (X 400). A HEMORRHAGIC LESION OF THE INTESTINAL WALL. HEMORRHAGE IS PROMINENT IN THE SUBMUCOSA AND MUCOSA. MUCOSAL GLANDS SHOW SLIGHT DISINTEGRATION. MUSCULARIS INTACT.

lesions the first evidence of injury is rupture of the capillaries and hemorrhage into the interalveolar septum with separation of the two layers of alveolar epithelium. From this point it appears that two things happen. First, the extravasated blood spreads as interstitial hemorrhage along the septal wall to collect about bronchioles and larger vessels. Second, the extravasated blood in the interalveolar septa dislodges the alveolar epithelium and finds its way into the alveolar space where it is seen as a thin layer of blood cells adhering to the alveolar walls. In lesions of greater degree the interalveolar septa, including capillaries and epithelium, are disrupted and destroyed, with hemorrhage pouring directly into the air spaces, and traumatic emphysema is produced.

The hemorrhagic gastro-intestinal lesions showed extravasation of blood into the wall, chiefly into the mucosa and submucosa. The



5. COLON OF RAT (X 35). SHOWS A NEAR PERFORATION OF THE WALL. UNDOUBTEDLY A FRANK PERFORATION WOULD HAVE RESULTED IN A SHORT TIME.

perforating lesions showed the intestinal tissue surrounding the perforation to be thin and disintegrated or shattered, resembling tissue that has been crushed. Hemorrhagic extravasation into the adjoining tissues was not marked.

The absence of gross brain lesions was uniform in all animals blasted in the usual manner with heads above the surface. Four guinea pigs were subjected to minimal lethal charges with only their heads submerged at the instant of the explosion. All bled immediately from the nose and mouth and were unable to stand upon being removed from the water. The blood was frank hemorrhage and not frothy. For 15 minutes they continued to lie unconscious and gasping for breath. At the end of this period they recovered and attempted to stand, unsuccessfully at first, but soon were able to walk and eat. Two animals upon becoming conscious developed a hind-foot-to-ear scratch-

ing reflex that persisted for several minutes. Three animals appeared fairly normal after 2 hours. The fourth died at the end of 15 minutes and was found to have a fracture through the base of the skull. The animals that survived were sacrificed after 2 days. All had extensive epidural and subdural hemorrhages and one animal had a skull fracture. Two of the animals showed extension of the hemorrhage down the spinal canal.

It is conceded that the observation of central nervous system damage is incomplete and unsatisfactory. Published articles and personal communications with competent observers indicate strongly that it occurs, yet it was not observed in this series except in animals exposed as above. Intrinsic disruption of nervous tissue is an extremely difficult thing to demonstrate by histopathological methods even when there is clinical evidence that it existed. Further experimental and clinical observation is required to clear up this point.

It has been reported that victims of underwater concussion complain of pain in the scrotum and testicles, or that these structures show severe injury. Most of the animals used in this study were males and none showed either gross or microscopic injury in these tissues. That the compression wave produces pain in tissues not otherwise damaged may be demonstrated by placing a finger in the water at the moment a sublethal charge is exploded. A sharp, distinctly unpleasant sensation is produced which persists for a few minutes. Undoubtedly unpleasant or painful sensations are produced upon any part of the body exposed to a blast wave of any magnitude.

NATURE OF THE BLAST WAVE

Air-borne blast consists of a shell of compressed air that moves outward in all directions from the explosion center. A cross section of the shell is a steep fronted wave followed by a negative or suction phase. The compression phase reaches its maximum intensity almost instantaneously and moves away from the explosion center at an extreme velocity, but as it travels outward the base tends to move somewhat more slowly than the crest so that the wave breaks in much the same manner a wave on the seashore does, hence it continually loses amplitude until it eventually becomes an ordinary sound wave. The suction phase is one of negative pressure but never exceeds a perfect vacuum, which is 15 pounds per square inch. The magnitude of both phases is directly proportional to the size of the charge used. The compression phase has a duration of 0.005 to 0.008 second and the suction phase about 0.025 second. The pressure exerted by the compression phase varies with the square of the distance. Air-borne pressures are considerably less than water-borne pressures.

The concussion wave of an underwater explosion of TNT or tetryl is produced by the detonation which requires approximately 0.005 second and travels through the charge at 20,000 feet per second. Its velocity in water is 4,800 feet per second which is the speed of sound in water. The pressure reaches its maximum intensity in less than 1 millisecond and subsides inversely with the distance, except in the immediate vicinity of the charge, that is 20 charge diameters, where the fall in pressure is much greater. The disturbance caused by the explosion in the water consists of two phases. The (*a*) phase, or compression wave, is the destructive factor, and the (*b*) phase the disturbance produced by the expanding bubble of gases liberated by the explosion. The (*b*) phase is not destructive.

The compression phase tends to reflect as a tension wave when it strikes another medium. This occurs when it strikes the surface of water but if its pressure is approximately 500 pounds per square inch, or greater, it breaks through into the air with a shredding effect and literally "blows off" the surface. Webster's New International Dictionary defines the transitive verb, "shred" as follows: "to cut or tear into small pieces, especially narrow and long pieces, as of cloth or leather; to tear into shreds." Shredding is the term used by physicists to describe the effect of the compression wave upon the surface of the water. When the phenomenon is studied in slow-motion pictures it is seen that water is forcibly projected from the surface into the air as fingerlike projections or strips and to this extent is best described by the term used.

When the air exists as a bubble within an enclosed space there is an additional effect consisting of collapse or compression of the bubble for that fraction of a second during which the compression wave acts. The air reexpands immediately upon passage of the wave.

DISCUSSION

The determining factor in the production of injuries by blast is the presence of air or gas in the tissues. The observations of Hooker and Zuckerman in animal experiments and the clinical records of patients treated for air-blast injuries prove conclusively that pulmonary tissue is extremely susceptible. Our observations confirm this in underwater blast. The only other structures that normally contain air or gas are the gastro-intestinal tract, the upper air passages, and the accessory nasal sinuses, and these showed susceptibility to injury in this series of study.

Two additional experiments carried out during this study tend to prove the correctness of the relationship between injury and the presence of air in the tissues. Twenty cubic centimeters of air was injected into the peritoneal cavity of a rat which was subjected to a

lethal underwater blast. In addition to the usual pulmonary injuries, laceration of the liver and spleen and extensive hemorrhage into the abdominal wall resulted. Injuries of these structures were not seen when normal animals were blasted. The second experiment consisted of removing four short segments of normal rabbit intestine. They were tightly ligated at both ends after the first was completely collapsed, the second filled with air, the third with normal saline solution and the fourth with air and saline solution. They were then submerged and subjected to underwater blast. The collapsed segment and the one filled with saline were unaffected but the two containing air were ruptured.

When a compression wave greater than 500 pounds per square inch strikes the body it is transmitted through the tissues and upon striking the air within the lungs or the gas bubble within the gastrointestinal tract it breaks through into the gaseous medium with a shredding effect, tending to "blow off" the surface of the tissues exactly as it blows off the surface of water when it breaks through into air. This is sufficient to damage the alveolar walls. These delicate structures will be injured by the slightest shredding action, the capillaries being the most vulnerable and the first to break down, followed by disintegration of the other components of the alveolar wall. Gastro-intestinal tissue, as such, is resistant to the effects of the compression wave but if gas is present in the lumen the wave will shred as it breaks through. If the gas can be displaced without compression a hemorrhagic lesion of the wall, marking the site of the shredding, will be the only result. Perforation will occur when the gas bubble is trapped. It becomes compressed under the pressure of the wave and snaps back in reexpansion when the wave passes. If the wall has been sufficiently weakened by the shredding injury it will break down before the reexpanding bubble and a "blow out" perforation will result.

Zuckerman was of the opinion that larger animals were less susceptible to injury than smaller ones. The present study tends to confirm this as regards water blast. An attempt was made to determine whether there is a critical pressure beyond which injury occurs regardless of size or species. This was not found although it is apparent that the difference in critical pressure for large and small animals is not very great. When the pressure approaches 500 pounds per square inch, pulmonary damage may be expected. Smaller animals are slightly more sensitive but the difference is probably due to the relative thickness of body walls and to the resistance offered by them to the compression wave.

The pressure per square inch developed by the underwater explosion of TNT or tetryl may be calculated by the formula: $\frac{13000 \times \sqrt[3]{w}}{d}$

in which w is the weight of the charge in pounds and d the distance in feet. When a 300-pound depth charge is exploded the resulting compression wave will exert a pressure of 500 pounds per square inch at a distance of 174 feet. A 600-pound depth charge will produce the same pressure at a distance of 218 feet. The pressure increases as the distance shortens. At 100 feet, a 300-pound depth charge will exert a pressure of 871 pounds per square inch and a 600-pound charge, 1,092 pounds. At 50 feet, the pressure will be 1,740 and 2,180 pounds per square inch, respectively. These figures are the approximate pressures and the distances represent the actual distance between the charge and the target, which is the hypotenuse of a right-angled triangle, the other two sides of which are the distance below the surface of the charge and the distance on the surface from a point directly over the charge to the target.

PRACTICAL APPLICATIONS

Translating these observations into the field of practical application one sees that they fall naturally into two categories. The first is the prevention or minimizing of the injuries and the second is intelligent treatment of injuries based upon the type of injury that may occur. Zuckerman reported that when his animals were protected by a covering of foam rubber about the trunks injuries were minimized. Similar studies were undertaken in these experiments.

Four materials were investigated—foam rubber, kapok, adhesive plaster, and thin metal obtained from the metal packing material in a blood plasma container. Coverings resembling life jackets were made of kapok and foam rubber and fitted on the animals. Some of the animals had their entire trunks protected, others only their thoracic regions. The same procedure was followed with adhesive plaster. The metal was cut and fitted to encase the trunks, thorax or abdomen like a suit of armor. The cut edges were padded by adhesive plaster. It was impossible to make these metal devices cover the thorax completely without leaving small areas unprotected about the axillae.

The animals protected by these materials were subjected to underwater blasts varying from sublethal to two and a half times lethal charges. The adhesive plaster was the least satisfactory. It minimized injury and prevented immediate death when minimal lethal charges were used but its protective power was not promising enough to warrant its further consideration. Metal afforded complete protection to lungs and gastro-intestinal tract, except that severe lung damage occurred beneath areas of the thorax left uncovered. Its great disadvantage lay in the number of fractured extremities that resulted when it was used. This is believed to have been due to the

extremities being forced against unyielding metal by the compression wave. Foam rubber and kapok provided satisfactory protection, if they were prevented from becoming waterlogged. It was found that neither afforded protection when saturated with water. Animals completely protected by dry kapok received only minimal lesions when subjected to two and a half times the lethal charge. The following table shows the results of these studies:

Results of protection experiments using minimal lethal charges

Thorax protected by	Abdomen protected by	Results
Adhesive plaster.....	Adhesive plaster.....	Animals survived the blast, but lungs and G.I. tract were severely injured.
Adhesive plaster.....	No protection.....	Animals survived but lungs were severely damaged. G.I. tract injuries occurred.
Metal.....	Metal.....	Abdomens well protected. Lungs well protected except in areas underlying parts of the thorax which could not be satisfactorily covered. Fractured extremities were common.
Metal.....	No protection.....	Lungs protected as above. G.I. tract injuries. Fractures of the forelegs resulted.
Kapok (dry).....	Kapok (dry).....	Complete protection. Minimal lung damage when $2\frac{1}{2}$ times lethal charges used.
Kapok (saturated).....	Kapok (saturated).....	Animals survived. Severe lesions in lungs and G.I. tract.
Kapok (dry).....	No protection.....	Lungs protected. G.I. tract lesions.
Kapok (saturated).....	No protection.....	Animals survived. Severe lung injuries. G.I. tract injuries.
Kapok (dry).....	Metal.....	Complete protection of lungs and G.I. tract. Fractures of hind legs.
Foam rubber (dry).....	Foam rubber (dry).....	Complete protection.
Foam rubber (saturated).....	Foam rubber (saturated).....	Animals survived. Severe lung and G. I. tract injuries.
Foam rubber (dry).....	No protection.....	Lungs protected. G.I. tract injuries.
Foam rubber (saturated).....	No protection.....	Animals survived. Severe lung injuries. G. I. tract injuries.
Foam rubber (dry).....	Metal.....	Complete protection of lungs and G.I. tract. Fractures of hind legs.

It is believed that the protective action of kapok and foam rubber is due to their ability to disperse the compression wave sufficiently to prevent or minimize its destructive effect. Adhesive tape and metal, being of greater density than water, produce reflection of the wave and thus afford protection in proportion to the amount reflected.

Any protective device must have certain properties before it can be given serious consideration. It must possess definite protective qualities. It must be so fashioned that its adjustment is as simple and easy as possible. When worn by men it must not interfere with their actions in carrying out their duties aboard ship, and lastly, it should be made of materials that are available without high priority ratings. It is believed that the ordinary life jacket, made of kapok or a similar material, with slight modifications meets these requirements. Such a life jacket should be of the sleeveless coat type. The kapok should be enclosed in muslin bags and these encased in a pliable, waterproof material. The kapok in its two containers should then be placed in compartments of the outer covering of the jacket.

There should be an attached, padded collar that fits snugly about the neck when tied in front. The coat should be slightly double-breasted and the skirt should reach to the greater trochanters of the femur. Three ties across the front of the jacket should make it fit snugly against the body and it should have a padded "tail" attached behind to the bottom of the skirt, and long enough to be drawn between the legs to be tied in front, thus forming a crotch piece to protect the scrotum and testicles. The thickness of the pads used in the body of the jacket should be same as that now used in the standard Navy life jacket. Such a jacket when properly adjusted would provide maximum protection to lungs and abdomen and would prevent the wave from striking the scrotum. The buoyant qualities of the jacket would be increased and its increased size would enhance its protective qualities against cold.

Personnel should be instructed in how to cope with underwater blasts. The following set of instructions are offered for consideration :

1. Wear your life jacket properly tied and adjusted. It is a "life preserver" that will protect you from underwater explosions as well as from drowning.
2. Swim away from an expected underwater explosion as rapidly as possible. You will be safe at a distance of 165 feet from a 300-pound depth charge, or 220 feet from a 600-pound depth charge, even without your life jacket and at a considerably less distance if you are wearing it.
3. Make use of any floating object that will support you to draw yourself out of the water, particularly your chest.
4. Keep your head out of the water and when resting float on your back, as high in the water as possible. Remember only those parts of your body that are submerged will be affected by the underwater explosion.
5. Do not lie on a partly submerged raft when underwater explosions are expected. Stand or sit so that the shock will not be transmitted to your chest or abdomen.

Successful treatment of any condition is predicated upon a correct understanding of the underlying pathology. In the lungs the affected areas are torn and disrupted, and more or less traumatic emphysema results. In addition there may be a pneumohemothorax present. Bleeding into the air passages occurs and the patient coughs up blood. Pulmonary edema makes its appearance early and is present even in minimal injuries. This is strikingly seen when normal lungs are placed beside lungs that have received minimal, sublethal, or lethal injury. This type of pathology in the lungs renders the patient's condition critical because the danger of asphyxia is imminent. Such a patient requires rest and quiet, physical and mental, and oxygen therapy. If he survives the critical period of threatened asphyxia he still is faced with the possibility of inflamma-

tory complications. This must be kept in mind until complete recovery takes place.

The two types of lesions that occur in the gastro-intestinal tract make it mandatory to differentiate between them before treatment is undertaken. The lesions may be multiple and may occur in any part of the gastro-intestinal tract from stomach to rectum. The hemorrhagic lesions are due to disruption of mucosa and submucosa and will present many of the features of a surgical abdomen such as pain, rigidity, tenderness, and bloody stools. Ileus has been reported in the literature as being observed. In spite of this the big majority of these lesions will heal under a regime of conservative therapy. Perforation does not exist and will not occur in many cases if the lesions are given the opportunity to heal by keeping the patient quiet and providing as much functional rest for the gastro-intestinal tract as possible. The perforating lesions, of course, require positive surgical intervention as a life-saving measure, as do peritonitis and the occurrence of peritoneal abscesses.

CONCLUSIONS

1. The presence of gas or air in the tissues is the determining factor in the production of underwater blast injuries.
2. The lungs are particularly susceptible to injury. The gastro-intestinal tract is also susceptible but to a less degree.
3. Injuries occur in the skull and upper respiratory passages when the head is submerged at the time of the explosion.
4. Pathological changes were not observed in solid organs and in tissues that do not contain air or gas.
5. The underwater concussion wave produces tissue injury by shredding the tissues as it passes into a gaseous medium within the body.
6. Kapok and foam rubber prevent or minimize the injurious effects of the compression wave.

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EXPERIMENTAL IMMERSION BLAST INJURY¹

PRELIMINARY REPORT

By MORRIS T. FRIEDEL, Lieutenant, Medical Corps, United States Naval Reserve,
and ARCHIBALD M. ECKLUND, Medical Corps, United States Naval Reserve

The experience with immersion blast injury at this hospital after the battle of Midway was the immediate inspiration for these experiments. We wish to thank Captain J. J. A. McMullin, (MC), USN., commanding officer of the United States Naval Hospital at Pearl Harbor, for his suggestions, aid, and cooperation in the conducting of these experiments. The actual blast was carried out with the cooperation of the Mine Disposal Unit with Lieutenant, junior grade, Richard Burke, D-V (G), USNR, actively assisting.

The clinical and pathological findings have already been reported by other members of the staff of this hospital. In the series of cases under their observation, one of the most impressive features was the presence in several individuals exposed to immersion blast of evidences of a severe peritonitis. Findings by roentgenographic study demonstrated that gas and free fluid were present in the peritoneal cavity, and it was apparent that perforation of the abdominal viscera was present. Previous reports of perforations of abdominal viscera following immersion blast exposure have appeared (1). In air blast the most serious lesions are in the chest, and damage to the lungs is the predominating factor. O'Reilly and Gloyne (2) reported a series of 17 air-blast cases in which 2 exploratory laparotomies were performed. Both patients died post-operatively. At the time of operation and at postmortem examination only subserous hemorrhages were noted in the intestinal walls, and no perforations were noted. This is one of the few notations regarding abdominal injury in severe air blast. Dr. Joseph Palma did not notice evidences of abdominal injury in a series of air-blast injuries reported from this hospital.

The cases of immersion blast were thus distinguished from air blast in that aside from the chest lesions abdominal trauma of a serious and even overwhelming nature was present. The lesions in the lungs are similar in both types of blast injury.

PURPOSE OF EXPERIMENTS

The experiments to be reported were undertaken to determine the types of abdominal and other injuries caused by immersion blast.

¹ Received for publication October 16, 1942.

The factors which led to the production of intestinal perforation were the particular objects in mind. The pathogenesis of the lesions was in doubt, and the question was raised whether the perforations had occurred immediately or were the delayed effect of severe intestinal trauma. This was of particular significance since the problem of an immediate laparotomy must be considered in the case of immersion blast injury with abdominal symptoms. The previous reports of hemorrhagic areas in the bowel following blast injury led to the impression that it was possible that severe hemorrhage into the wall of the bowel was followed by necrosis of the wall with perforation and peritonitis. Another theory raised was that water or air was forced up into the rectum and the resulting distention ruptured the bowel. A factor which was puzzling also was the frequent location of the perforations in the first loop of the jejunum, the terminal ileum and the colon. The stomach and other viscera were intact. Why these areas demonstrated perforations was obscure. Hemorrhagic areas in the bowel were noted also. The importance of these lesions, their location, and the time of appearance of perforation following blast injury, were significant questions which were of vital importance to the first surgeon seeing these cases. The questions of immediate operation, and what to do in regard to lesions encountered, especially hemorrhagic areas in the bowel, were posed, and finally some means of protecting the abdomen was to be discovered, as apparently the chest had been protected by the life belt.

EXPERIMENTAL SET-UP

The experiments were undertaken with a goal of duplicating some of the lesions found in the abdomen following exposure to immersion blast. A large steel tank 8 feet long and 6 feet wide and about the same depth was obtained. Water was placed in the tank to a depth of over 4 feet. Guinea pigs were the animals which were available at the time. The choice of explosive was limited since the charge had to be small, readily controlled, and easily available. Detonating caps containing a charge of 35 grains of fulminate of mercury were used. These were convenient and could be detonated electrically. It should be noted that this is an extremely brisant type of explosive. (The theory of the explosive force is discussed in an appended report.)

The experiments were begun with the animals at a considerable distance from the explosive, and using one detonating cap. Two charges were then used at a lesser distance, and so on, until it was found that at about 18 inches from the animal, using two charges, a

fatal outcome was inevitable. An animal was fixed in a large wire mesh so that his entire body was submerged except for the head and shoulders. The abdomen was directed down and almost parallel with the surface. The charges had to be set off directly underneath the animal at a distance of 18 inches in order to produce death. At this distance and using two charges, death resulted in about 5 minutes after the explosion, and always in the same manner, i. e., with the same train of symptoms. Variations in position had a definite effect, and will be discussed later. The brisant nature of the explosive was noted in that an increase of 2 to 20 inches in the distance failed to produce a lethal outcome.

EXPERIMENTAL RESULTS

The first objective of the experiments was to determine the types of lesions produced by minimal lethal blast. The minimal charge and the minimal distance was therefore determined and this distance used as a standard.

Experiment No. 1.—No effect on the animal was noted using a single detonating cap at a distance of 52 inches.

Experiment No. 2.—Distance of the charge from the guinea pig reduced to 36 inches with no visible damage.

Experiment No. 3.—Two charges were exploded directly underneath the animal at a distance of 2 feet. There was no visible effect on the animal.

Experiment No. 4.—Two charges were placed under the fourth pig at a distance of 18 inches. Immediately after the explosion the animal was quite lively, and although stunned, struggled to escape. There was some blood staining in the vicinity of the nares. In about 3 minutes air hunger developed, minor convulsions and twitchings appeared, and the animal expired 5 minutes afterward.

Autopsy Pig No. 4.—Beginning with the rectum, subserous hemorrhages were noted predominantly over fecaliths and scybala, although this condition was not found over every fecal collection. The hemorrhagic changes reached their maximum intensity in the colon about 24 cm. from the anus. In this area a segment of bowel 9 cm. in length was purplish black in color from subserous extravasation of blood. The supporting mesentery was not grossly damaged. The remainder of the colon showed small areas of subserous hemorrhages. In the small bowel (terminal ileum) there was an area 3 to 4 cm. in length which was hyperemic and there was a small pin-point perforation in this area. The stomach, liver, spleen, and kidneys were not grossly damaged. The lungs showed symmetrical gross hemorrhagic areas on the antero-medial and dependent margins of the middle lobes. The pericardium was empty, and the heart was apparently intact.

Microscopic study revealed the hemorrhagic areas in the bowel to be in the muscular coats, extending from the submucosal to the subserosal layers. All the hemorrhagic lesions in the bowel were of this nature. The lesions in the lung were chiefly hemorrhage into the inter-alveolar walls, although some intra-alveolar blood was present.

Experiment No. 5.—In this experiment the animal was placed on his abdomen and almost completely immersed. Two charges were exploded 24 inches below the animal. No obvious ill effects were noted although the animal did not react normally for several days.

Experiment No. 6.—This animal was exposed to blast with the same charge distance as the animal in experiment No. 5 except that he was placed on his back. No ill effects of any kind were observed and the animal behaved normally following the blast.

Experiment No. 7.—Two charges were placed 18 inches below the surface of the water. The animal was completely immersed except for the head, abdomen down, and parallel with the surface of the water. This animal developed the same train of symptoms as pig No. 4 and died in the same manner 5 minutes after the blast. The animal likewise seemed to have survived well for the first 3 minutes and then succumbed. Air hunger was the first symptom to appear, minor convulsions followed and then death.

Autopsy Pig No. 7.—Bleeding from the nostrils was noted. The abdominal wall was uninjured. There were areas of subserous hemorrhages over the colon and small bowel, and especially over the enlarged appendix. Again most marked changes were noted over fecal collections. The lungs showed hemorrhagic areas of a symmetrical nature. The antero-inferior margins were extremely hemorrhagic, and the lower half of the upper lobe as well as the middle lobes were affected. The other anterior portions of the lungs were much less affected, and only on their inferior surfaces. The posterior surfaces of the lungs were not affected. Microscopic study revealed no perforations in the intestinal tract, and the hemorrhagic areas in the bowel were in the same location as in pig No. 4, the muscular coats again demonstrating the hemorrhagic area. The lung findings were quite similar to those in pig No. 4.

Experiment No. 8.—Three charges were set off at a distance of 24 inches. The animal recovered from the initial effect of the blast, and while showing some air hunger never gave evidence of succumbing. He was sacrificed with chloroform anesthesia about 30 minutes after the blast. Autopsy showed very slight subserous hemorrhages in the region of the cecum and also over fecaliths in the colon and a few areas in the small intestine. The lungs showed changes definitely less than in pig No. 7. The antero-inferior margins of the most anteriorly lying lobes were affected. The posterior lung edges showed no changes, and the posterior halves of each lung were not grossly

affected. Microscopic study revealed changes similar to those found in the previously autopsied animals, except that intestinal perforations were not seen.

Experiment No. 9.—Two charges were set off 20 inches below the surface. The animal was submerged except for the head with the abdomen down and parallel to the surface. This animal was observed over several days, soon recovered normal behavior, and suffered no prolonged after effects.

Experiments Nos. 10, 11, and 12.—In an effort to determine the comparative effects of simultaneous exposure to blast with variations of position and with protection to the chest, three animals were placed in the water at once and parallel with each other. One animal was placed in the previously selected position of semi-immersion with the abdomen down. A second pig was placed in the water in the same position but with a heavy piece of corrugated cardboard fastened about the thorax to offer some degree of protection to the chest. A third animal was placed parallel to the others and at the same depth but on his back. The charge of two detonating caps was set off at a distance of 16 inches below the surface, and directly underneath the central animal. The animal without protection and on his abdomen died as had the others in about 5 minutes. The animal with the protection to the chest survived and while ill for 2 days, taking no food and little water, soon made a complete recovery. The animal on his back, although quiet for the first day, seemed little the worse for the experience.

Autopsy on Pig No. 10 showed findings quite similar to the previous autopsy notations. Microscopic study again revealed hemorrhage in the muscular and subserous coats of the intestinal wall, and typical changes in the lungs of inter- and intra-alveolar hemorrhage.

The next series of experiments were carried out with the object of preventing the chest lesions or at the least minimizing them. To this end a method was devised of protecting the chest and head of the animal from any secondary air blast, allowing its exposure to a larger explosive charge. The question of secondary air blast was raised because the head of the animal was always out of water and because the size of the charge necessitated placing it relatively close to the surface. A small chamber was devised from a tin at the open end of which was placed a rubber diaphragm, in which a small opening was made. The head and thorax of the animal were inserted through the diaphragm so that only the abdomen was in the open. Two small holes were made at the upper end of the chamber for ventilation. The animal was then fixed into place in the wire mesh screen, and placed in the water

so that the entire lower end of the animal was in the water, the abdomen being down and parallel with the surface. Charges which had previously proved lethal to the unprotected animal were then set off and proved ineffective (experiment No. 13).

Experiments Nos. 14, 15, and 16.—Three more pigs were placed in the chamber and the distance shortened so that a charge was exploded (two detonating charges) 14 inches below the surface of the water. None of these animals were killed and under observation suffered no apparent after effects.

Experiment No. 17.—This animal was protected with the chamber as in experiments 13 through 16 and two detonating charges were exploded 14 inches below the water surface and directly under the animal. The animal was placed as in the previous experiments. He survived the blast and was sacrificed 1 hour later, chloroform being used.

Autopsy on Pig No. 17.—A moderate amount of hemorrhagic changes was found in the intestines. The lungs showed much less blast damage than in any previously autopsied animal. On the anterior surface of both lungs and confluent with the medial edges were small patchy areas of gross hemorrhagic consolidation. These were not as intense as in the fatal cases and were limited in area. No free blood was present in the pleural cavity. The intestinal tract showed a few areas of subserous hemorrhages in the colon and the appendix. There were some discolored areas in the lower ileum. No perforations were noted. Microscopic study showed the changes in the bowel wall to consist of hemorrhagic areas in the muscular coats.

In an effort to increase the pressure over the abdominal area, the explosive charge was then augmented with an additional detonating cap, and three charges were set off 14 inches below the protected animal. This animal also survived the effects of the blast and was sacrificed within an hour, under chloroform.

Experiment No. 18.—Three charges were exploded 14 inches below the water, with the animal in the same attitude and protected as in the immediately preceding experiment.

Autopsy on Pig No. 18.—There were several discolored areas in the colon and cecum ranging from 1 to 2 mm. to 1 to 2 cms. in diameter. In the lower end of the colon near or in the rectum there were two small perforations on the anti-mesenteric surface from which gas bubbled. The intestine at this point contained free blood. Both lungs showed symmetrical typical changes such as found in the previous animals, although much less severe than in those that had died immediately.

It was evident that blast injury to the lungs was the immediate cause of the lethal outcome. This blast injury was of a hemorrhagic nature and usually symmetrically placed on the anteromedial portions

of the dependent lobes of the lung. The lesions in the intestinal tract were of two types, first a hemorrhagic lesion limited to that portion of the intestinal tract which contained gas or fecal matter; and second, perforations, usually minute. Perforations were the lesions which we had attempted to produce, and these could be attained only when the animal was placed in close proximity to the explosive.

Experiment No. 19.—A portion of corrugated cardboard covered with rubber was fitted to the chest and abdomen of the guinea pig so as to cover the front and sides of the animal. The animal was then inserted in the water with the abdomen down and parallel to the surface. Three charges of the usual strength were detonated 14 inches below the animal.

Experiment No. 20.—This was conducted in conjunction with experiment No. 19. The animal was placed side by side with animal 19 and in the same position, but no protective devices were used.

Experiment No. 21.—This animal was exposed to a separated charge but under the same conditions as in the last two experiments except that the animal was placed on his back.

It is deemed advisable to discuss the results of these three experiments together since they were conducted under the same conditions. Animal 19 died 10 minutes after exposure to the blast.

Autopsy animal No. 19.—Hemorrhagic areas were present on the left and right lungs in the anterior and dependent portions, somewhat symmetrically placed although more prominent on the right side. Scattered hemorrhagic areas were present in the subserosal portions of the small intestine, the appendix, and the colon.

Animal 20 died 23 hours after exposure to the blast. This animal had been unconscious for 2 minutes after the blast but no other ill effects were noted. At the time of the death the animal had abdominal distention and there was some blood staining around the nostrils and mouth.

Autopsy Pig No. 20.—Generalized peritonitis was present and there was fecal and purulent material in the peritoneal cavity. Four perforations were present in the small intestine and colon, some of which were partially sealed by omentum and fibrinoplastic exudate. The lungs showed evidences of blast injury and there was free blood in the peritoneal cavity. The blast injury in the lungs had progressed to a stage of adjacent inflammatory reaction with a hemorrhagic type of pneumonia supervening.

Animal 21 died almost immediately after the blast. There were indications that the spine had been fractured.

Autopsy Pig No. 21.—The peritoneal cavity was filled with fecal material which originated from a perforation in the appendix. Another perforation was

present about 2 inches above the rectum in the colon. Evidences of hemorrhagic traumatic lesions were present over several gas bubbles in other portions of the colon. The lungs showed changes typical of blast, with confluent distribution on the posterior surface of the lungs. The anterior edges were distinctly free of hemorrhagic changes.

These three experiments demonstrate that intestinal perforations are produced by good-sized charges at a distance short enough to prevent diminution of pressure effects. The effect of the medium transmitting the pressure was adequately indicated by the following experiment.

Experiment No. 22.—The animal was suspended in air and three charges were detonated 14 inches below the abdomen of the animal. Fortunately the animal was not struck by flying fragments of the casings. This animal demonstrated such little change after this exposure that it was not deemed necessary to sacrifice it.

This series of experiments revealed the significance of the water medium in transmitting explosive pressures, and that protection to the abdomen was best offered by a rigid covering. Protection to the chest required more adequate means, as has been described. Exposure of the back to the blast was not satisfactory in the presence of heavy charges at short distances, although lending some protection on exposure to lesser charge distances.

It was known that with a brisant explosive such as mercuric fulminate the pressure reached its maximum almost instantaneously and then fell rapidly both in the matter of time and in distance from the explosive source. It was also speculated that an explosive with relatively less brisance, which generated more pressure and which maintained that pressure for a relatively longer time and on which distance had less effect, was more destructive. A form of TNT was selected similar to that used in depth charges and mines. Two ounces was the quantity selected.

Experiment No. 23.—A rabbit was fixed in a small box made of coarse wire mesh ($\frac{1}{4}$ inch) and placed in the water so that the abdomen was down and parallel with the surface, with the head and shoulders not immersed. Two ounces of TNT were detonated by a blasting cap under the animal at a distance of 24 inches. The animal seemed disturbed for a day and then recovered. He showed no after effects.

Experiment No. 24.—A rabbit was fixed in the same way. Four ounces of TNT were detonated with a single blasting cap. The explosive charge was 26 inches below the surface of the water and directly below the animal. A violent explosion occurred this time and the animal was thrown with a column of water about 10 or 12 feet into the air. He was killed outright.

Autopsy on animal No. 24.—Multiple fractures of all four extremities were present. There was no apparent skull fracture. In the thorax free blood was present in both pleural cavities, and there was extreme pulmonary hemorrhage, more pronounced on the anterior surfaces of the lungs. The heart showed no change. There was free blood and fluid in the peritoneal cavity. The liver, spleen, and stomach were not apparently damaged. The intestinal tract showed numerous perforations. Beginning with the duodenum there were two perforations 8 cm. from the pylorus. A third perforation was present in the jejunum, just beyond the duodenum. There were four more perforations in the terminal ileum. There was a large linear tear in the appendix, and a smaller one in the ascending colon. There were three more perforations over fecal collections in the colon. The capsule of the right kidney was torn and the parenchyma lacerated. The free blood seemed to have come from this particular injury. There were no evidences of wounds in the abdominal wall. The mesentery was entirely free from tears or hemorrhage. The brain showed no gross damage.

SUMMARY OF RESULTS OF EXPERIMENTS

Two types of abdominal lesions were discovered:

1. A hemorrhagic condition of the muscularis portion of the bowel wall.
2. Perforations and larger tears in the bowel wall.

The lesions in the chest were constant, symmetrical areas of hemorrhage on the surfaces of the lung which were nearest to the explosive source. Thus the dependent edges of the middle lobes on both sides were usually involved, and the posterior surface was involved when the back was turned toward the blast source. The thoracic lesions varied in severity according to the distance of the explosion, the size of the charge, and the amount of protection afforded the thorax. The thoracic involvement accounted for the fatal outcome in most of the experimental animals. It was obvious shortly after the experiments were begun that abdominal lesions were not produced except when the lungs were so severely damaged that death ensued. This death occurred a few minutes after the explosion and the following train of events was noted in all cases: The animal was fairly lively for 2 to 3 minutes, air hunger then ensued (the eyes began to bulge) and minor convulsions followed. Death came 5 minutes to 10 minutes after the blast. To eliminate the severe lung injury a chamber was devised to minimize the effects on the thorax. With this chamber the lungs were protected so that previously fatal explosive conditions were no longer lethal. The abdominal lesions were present, however, and as the force of the charge seemed to grow greater, the hemorrhagic lesions gave way to perforations. When the force of the charge was overwhelming, perforations were frequently discovered. The effect of the charges apparently could be somewhat minimized when the animal was placed on its back.

COMMENT ON RESULTS

The clinical aspects of immersion blast varied from the usual picture of air blast in that abdominal lesions and peritonitis were present. There have been reports of severe abdominal symptoms in air blast cases, this leading to exploratory laparotomy in which merely hemorrhagic areas were found on the subserous aspects of the intestine. No perforations were recorded. Perforations have been mentioned in previous accounts of immersion blast. In the cases under observation at this hospital, it was felt that possibly the life jacket prevented such severe injury to the lungs as to cause death, and that the abdomen which was unprotected bore the brunt of the explosion. This seems to be borne out by the experiments in which the previous lethal condition was repeated, except that the chest was protected (experiment No. 18). Perforations were then found in the intestinal tract, and the animal survived the immediate explosion. At autopsy there was not enough found in the chest to have expected a subsequently lethal outcome. Peritonitis appeared in one animal which survived the pulmonary blast injury by 23 hours, thus duplicating the picture encountered in some instances of human immersion blast injury.

CONCLUSIONS

1. Hemorrhagic areas appear in the muscularis of the intestinal tract following immersion blast. Similar lesions have been described in severe air blast injury. Pulmonary damage occurs, and if severe enough leads to an almost immediately lethal outcome. If not severe, the animal almost invariably recovers. This is similar to observations on true pulmonary air-blast lesions.

2. Perforations of the intestinal tract occur over areas which contain fecal material in scybalous form, and probably over air bubbles, with resultant peritonitis. This would explain perforations in clinically observed immersion blast injury occurring in the colon and terminal ileum and the first portion of the jejunum. Perforations occur only in immersion blast injury and the force of the explosion is greater than that which produces the hemorrhagic lesions. The perforations are an immediate result of the blast, and do not occur later because of necrosis of the bowel wall. These perforations, therefore, demand early surgical intervention; hemorrhagic lesions do not require surgical treatment.

3. Protection to the chest was apparently afforded men exposed to immersion blast injury by the heavy rigid life jacket, and a rigid

covering was demonstrated as protecting the thorax of animals exposed to immersion blast. It seems reasonable to assume that extension of the life jacket to cover the abdomen would be beneficial. Swimming on the back affords some protection both to the chest and to the abdomen.

4. Theories as to the causation of immersion blast and air blast injuries are still controversial. There was no evidence in our experiments that water was forced through the anus with rupture of the bowel. The lesions seemed to be a direct effect of the explosive force itself transmitted through the elastic walls of the abdomen and thorax.

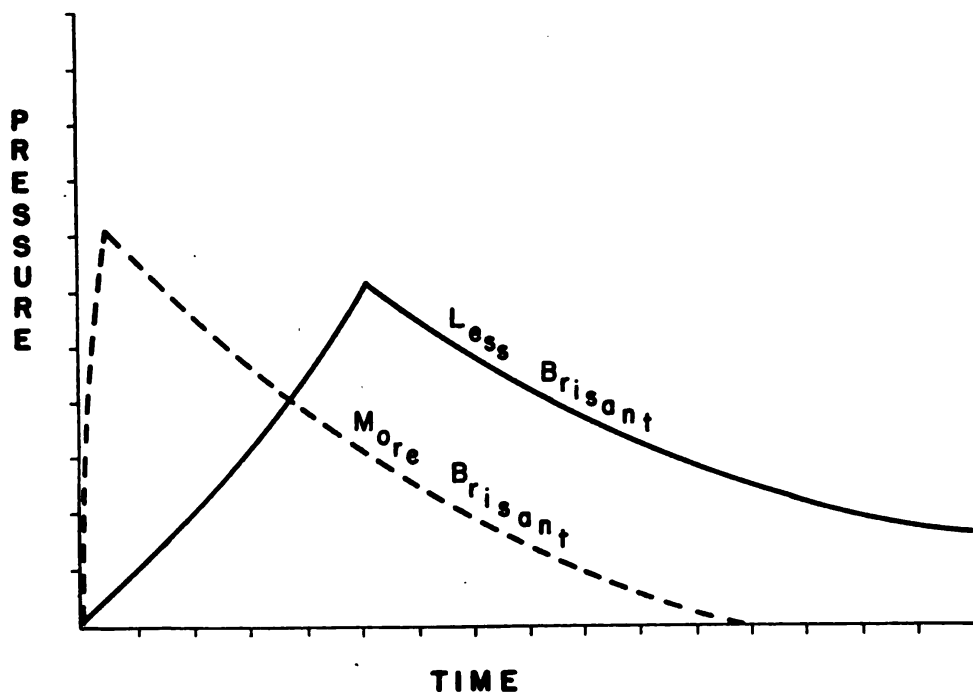
PRELIMINARY APPENDED REPORT ON THE CAUSATION OF BLAST INJURY¹

By **MORRIS T. FRIEDEL**, Lieutenant, Medical Corps, United States Naval Reserve,
and **RICHARD BURKE**, Lieutenant, junior grade, D-V (G), United States Naval Reserve.

A comparison of immersion blast injury with that following air blast necessitates considering the explosive system, and the medium transmitting the force, as well as the position of the exposed object (the body). Mention has been made of the varying brisant character of explosives. A definition of this term is not easy to propound. For the present it is most favorable to consider the term in regard to the rapidity of the detonation of the explosive. According to Brunswig,² "Many technicians are of the opinion that the detonation velocity is the main factor determining the brisance of an explosive system, and a high velocity of transformation is an important condition for the appearance of this phenomenon." In a highly brisant explosive such as mercuric fulminate (the explosive used in the experiments in the first phase) the velocity of detonation is so rapid that it produces its maximum pressure instantaneously, and this pressure fails rapidly (fig. 1). A slower explosive, that is, with less brisance will have a less steep gradient in pressure rise as calibrated in time, and will continue to exert considerable pressure for an increased length of time. The range of effects of brisance, according to Brunswig, is supposed to be confined to the immediate neighborhood of the explosion and it therefore exerts its greatest influence upon the medium with which it is in direct contact.

¹ Received for publication October 16, 1942.

² Brudawig, H.: *Explosives*. (Translated by Munroe, C. E., and Kibler, A. L.) John Wiley and Sons, Inc., New York.

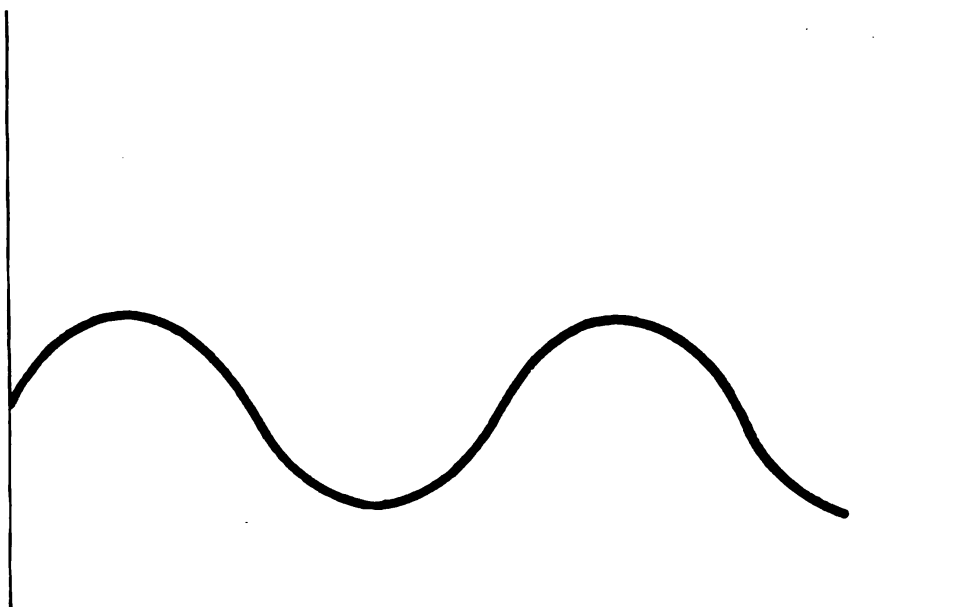


1.—ILLUSTRATING EXPLOSIVE PRESSURE CORRELATED WITH TIME FACTOR IN RELATION TO BRISANCE (AFTER BRUNSWIG).

Cronquist estimated that the pressure exerted by brisant explosives at a given distance was greatly reduced in comparison to less brisant explosives. While an explosive like dynamite would exert a pressure which would vary inversely proportional to the square of the distance, a more brisant explosive would exert a pressure which could vary inversely with higher powers of the distance (such as the fourth or fifth power). A brisant explosive such as fulminate of mercury while it leads to certain forms of lesions in the lungs and intestine of animals, does not exert sufficient pressure to cause perforations until brought in close proximity of the animal. This can be explained on the basis that the pressure area was greatest (instantaneous) in the very vicinity of the explosion itself, and that transmission of the pressure impulse was greatly mitigated by the distance of the explosion from the object. It was demonstrated that a distance of 1 or 2 inches was sufficient to prevent a lethal outcome in the guinea-pig experiments.

The medium transmitting the pressure must be considered. Blochmann devised a dynamometer which registers pressure as a function of time and obtained a curve which has two distinct maxima separated by an interval of about .05 second when there is 1 meter of water between the explosive and the dynamometer. Bichel is of the opinion that the first maximum is a measurement of the percus-

sive effect of the explosion and the second of the gas pressure (fig 2). This is different from blast in air and we believe the medium is the factor of prime importance. Zuckerman has shown that "taking a large bomb, no very serious pressures from the clinical point of view would be experienced 30 or 40 feet away, and at 60 or 70 feet the pressures did not really matter at all clinically, even though they



2. PRESSURE WAVES IN IMMERSION BLAST (AFTER BLOCHMANN).

might be sufficient to damage walls and windows." This may be compared to the recently observed cases of immersion blast injury in this hospital in which the victims were at much greater distances from the source of the explosion. There is no question that water being a dense and practically incompressible medium (although not so for great pressures) will transmit an impulse for longer distances with relatively more damaging effects. Again the brisant nature of the source of the explosion must be considered, thus if pressure is maximal instantaneously the force will dissipate rapidly with distance and will have less effect if pressure is produced somewhat more slowly. In air, of course a slow explosive may be ineffectual if pressure is not built up faster than it can be dissipated by the very fluid air medium. In water a relatively slower explosive may be more effective, especially where distance is a factor.

In our experiments it was noted that there were two types of lesions produced: (1) The hemorrhagic lesions in the lungs and the intestinal tract, and (2) the actual perforation of the bowel. While hemorrhagic lesions in both the bowel and lungs are typical of air blast, intestinal perforations are not. The following may be the explanation, and is based purely on the experimental observations, to the

present time, plus the characteristics of the type of explosive used and the medium.

As Blochmann has pointed out there are two types of effects following explosions under water. The first maximum is the percussive effect of the explosive. To use a familiar analogy, supposing the explosive force is considered to act on a row of billiard balls touching each other. If a ball is then rolled up to one end of the row, the force is transmitted to the ball at the opposite end and it alone rolls away. If it is conceived that whatever force rolled the ball up to the row continues to act after the row has been struck, then the entire row will move in the direction of the propelling force. A water blast may be considered to have this same effect, and indeed Guttman propounded the same idea in 1908. The first maximum or percussive effect is the result of the brisance of the explosion and if instantaneous the percussive effect is for all practical purposes the only acting force present. If pressure continues to develop, then the entire column of water is propelled in the direction of the propelling force. Thus it is propounded that the hemorrhagic lesions are the effect of the percussive force of the explosion, and represent a force greatly mitigated by the effects of distance. With a less brisant explosive, pressure continues to be exerted and expresses itself in the motion of the entire column of water. This force is much greater than the primary percussive blow depending on the velocity of the explosive itself. The impact of this massive force on the abdomen at great speed is, we believe, the cause of the perforations.

In the experiments conducted the use of the brisant explosive produced perforations only when in the close proximity of the animal. The use of a less brisant explosive produced a very violent explosion and had a great damaging effect. It can be contemplated that in air only the percussive effect of the explosion is of any magnitude, since the fluid character of air would prevent any great pressure building up secondarily as occurs in submarine blast. Indeed, it was shown that an explosion which was destructive at a given distance in water had no effect at the same distance in air.

CONCLUSION

A theory has been advanced for the effect of submarine explosion and its product, immersion blast, to account for the more destructive effects than are observed in air blast. Such a theory takes into account the brisance of the explosive, the elasticity of the transmitting medium, the density of the medium, and the relative factors of distance. Of the two types of lesions observed, (1) the hemorrhagic type is considered to be the results of the percussive effect of the blast; (2) perforations of the intestine are effects of the secondary blast pressure, or the concussive effect.

FIFTEEN DAYS ADRIFT ON A RAFT¹

A CLINICAL EVALUATION OF FIVE SURVIVORS

By HARRY S. GOOD, Lieutenant, Medical Corps, United States Naval Reserve

There is apparently an urgent need for an accurate evaluation of the experience of survivors from sunken ships. The experiences of those who have been adrift for a sufficient length of time so that their stores of food and water have been depleted, and who have suffered from immersion and continuous exposure to the elements is of real value. Also, the experiences of these survivors who have been on a raft where other men have died is of inestimable value in regard to making recommendations for measures which should be taken, and advice which should be given, to minimize casualties.

In the case under consideration, 4 survivors were rescued from a small raft and 3 hours later another was rescued from a lifeboat that was awash. The rescue occurred in the vicinity of the Grand Banks of Newfoundland in the middle of August 1942. The original complement of the torpedoed vessel was 41 men. Three small life rafts and one life boat came free from the ship after the sinking. Twelve men in all were able to board the rafts and the overturned lifeboat. Three were original occupants of each of 3 rafts and 3 clung to the overturned lifeboat. After clinging to this boat for 3 days, the men succeeded in righting it, one man being drowned during the process. The occupants of this boat and those of the raft were separated from the beginning.

One of the rafts with three men aboard was lost sight of by the other survivors and it was never seen again. One of the two remaining rafts began to break apart on the twelfth day, and one of the three occupants was able to transfer to the better raft. The 2 remaining on the damaged raft had been drinking sea water for 2 days, and as a result became irrational and were too weak to effect a transfer. They made no attempt to help themselves, and their shipmates were too weak to aid them. They drowned a few hours later when the raft broke up completely. This left a total of four men adrift on the remaining raft.

The duration of the period of exposure was 15 days. The average temperature of the water was 61°, and of the air 70°. The sun was not severe, it being foggy 70 percent of the time. While aboard the raft, the men were wet most of the time due to spray and waves breaking over the raft. They were not immersed in sea water except on three different occasions when the raft turned over. They were fully clothed during the 15 days exposure.

¹ Received for publication November 6, 1942.

The lifeboat was awash continuously after having lost 6 of its 10 buoyancy tanks in the process of being righted. The two men in the boat slept on the fore and stern sheets and used supports improvised from wreckage to support part of their bodies. In this position, half of their bodies remained submerged in the water. Their feet were immersed in water all the time. They lost their shoes and stockings on the fifth day, but otherwise were fully clothed.

ADEQUACY OF FOOD, WATER, ETC.

Originally, there was about 3 gallons of water on the raft, and the men were forced to get along on small rations of this drinking water. The water breaker had screw caps in both top and bottom, and after it was once opened, leakage occurred. The occupants of the raft added a small amount of sea water to their daily ration of fresh water in order to make it last longer. One half of the biscuits (about 40) were soggy and were covered with a green mold due to leakage through the screw caps in the food tank. The chocolate (about 2 pounds) and the malted milk tablets (about 300) were in good condition. They had no fresh water for the last 2 days, and 2 of the survivors drank pure sea water.

The lifeboat contained a 10-gallon wooden cask of water. However, the cask was submerged in sea water most of the time and the water soon became brackish due to leakage. On the tenth day, the water was so bad that it was dumped overboard. All of the food was in a single large metal container which was so secured inside the boat that the men were unable to get the container above water, and as soon as the tank was opened, water rushed in and ruined the contents. However, they had one case of condensed milk (48 cans) aboard and this proved to be a lifesaver. Each can contained about 14 ounces and they each drank 2 cans a day. The case was accidentally lost overboard on the tenth day. Soon after this, one of the men in the boat began to drink pure sea water in great quantities. He became irrational and on the twelfth day jumped overboard and drowned. The lone survivor of the boat had nothing to eat or drink for the last 5 days except 2 cans of condensed milk which he found lying in the bottom of the boat.

CLINICAL EVALUATION OF THE FIVE SURVIVORS

The survivors were very weak and had to be helped aboard the ship. All of them were conscious and rational except the survivor from the lifeboat who did not realize that he was being rescued. Almost all presented varying degrees of the same type of lesions and complaints. The survivors were under my observation for the first 5 days after being rescued, and were then sent to a hospital for further treatment and convalescence.

Skin.—All of the men had numerous superficial yellow pustules all over their bodies, ranging in size from the head of a pin to the size of a dime. There was only one deep infection of a finger, which responded rapidly to treatment. Three of the men had been immersed in oil at the time of the torpedoing, and the areas of skin that were black with oil were in much better condition than the rest of the skin. The oil-stained skin was softer, more elastic, and did not have as much infection as the harder, dry skin on the survivors not immersed in oil. None of them showed any evidence of capillary hemorrhage. One man developed a small bed sore overnight, denoting the poor condition of the skin.

Eyes.—Those that were immersed in oil complained of not being able to see well for about 4 days after the torpedoing and still complained of a mist before their eyes after being taken aboard. However, there was no sign of infection or physical abnormality to the eyes.

Mouth and tongue.—One man developed a severe case of aphthous stomatitis shortly after being taken aboard. On the inner surfaces of the lips and cheeks and all over the tongue, small and large, elevated, round and oval vesicles appeared. These vesicles ruptured, leaving superficial ulcers with grayish bases. His mouth became very sore and it was extremely difficult for him to eat and drink because of the pain. These ulcers seemed to coalesce so that in a few days the surface of the tongue was practically covered. The condition did not extend posterior to the anterior pillars of the tonsils. The other four showed a very parched condition in the mouth and throat, but they all responded to fluids within a few days. None of them showed any evidence of submucous hemorrhages.

Feet.—All survivors suffered a great deal from pain in their feet. For the first 2 days they had little feeling in their toes and then the feet began to tingle and hurt. They had a feeling of "pins and needles" constantly, and at times they suffered severe pains shooting from the feet half way up the lower leg. They were not able to sleep because of the burning pain in their feet. The feet had a dusky red appearance and the skin was dry and inelastic. The tips of the toes were hard, white, and numb. Circulation was good.

One of the men had drunk copious quantities of sea water the last 2 days on the raft. The second day after being rescued and after he had an abundance of fluids, both feet became markedly edematous. This edema, however, cleared up completely by the time he left the ship 3 days later. This man did not complain of pain in his feet until after the edema had subsided. This edema was due purely to the large quantity of sea water ingested. None of the other survivors developed edema at any time. The survivor from the boat, who had his feet immersed in salt water all of the time, had an area about the

size of a silver dollar on the top of each foot where the skin was fiery red and tender with beginning maceration. The feet were slightly swollen, but at this time he did not complain of much pain. These areas became larger and the skin became gangrenous, and when he left the ship, two large ulcers about $2\frac{1}{2}$ inches in diameter had developed on top of each foot. At this stage he experienced much more pain. The circulation was good. These two ulcerated areas were due to the friction of the cuffs of his trousers which were wet and heavy all of the time. He had no shoes or stockings on during the last 10 days on the lifeboat, and he stated that he kept pulling up his trouser legs continuously because the weight of the cuffs hurt the tops of his feet.

General musculature—All survivors were quite weak and lost considerable weight. The four survivors from the raft showed some muscle wasting and one in particular showed severe muscle wasting of the thighs and buttocks. The musculature was flabby, soft, and had no tone. The survivor from the boat, who suffered more from exposure and immersion than the others, showed signs of loss of weight but no muscle wasting. His muscles were firm and had good tone. This man had been drinking two cans of condensed milk a day for the first 10 days.

Psychological condition—As the ship came alongside of the boat, the lone survivor was sitting on the gunwale holding on with both hands, his feet immersed in water in the stern sheets. He looked around at us, turned away, and started to talk to an imaginary person in the boat. He became alarmed when we came closer and told us to go away or we would pile up on the rocks. He was able to answer questions but remained intermittently irrational for 2 days following rescue.

The survivors from the raft all responded normally to the rescue, but one of them, a young man of 23 years, was quite depressed afterward. He did not desire to be with his shipmates. He seldom smiled and wanted to be alone. He was a Christian Scientist. At nighttime, all the survivors were quite restless, waking up often during the night and thinking momentarily that they were still on the raft. All had irrational thoughts at times while they were on the raft. They dreamed of picnics at home and of automobile rides, etc. At one time or another they all thought that they could walk right off the raft. The two survivors who drank sea water for the last 2 days on the raft wanted to cut their own wrists and had to be dissuaded. All survivors agreed that drinking sea water for 2 days makes one become much more irrational than one who abstains.

Constitutional symptoms.—All survivors had temperatures ranging from 101° to 103° F. and pulses in the neighborhood of 120. Three days after rescue the temperatures and the pulse were normal except

for the survivor with the ulcerated mouth and the survivor with the ulcerated feet. The heart and lungs of all were negative. Two suffered from severe constipation requiring enemas, and resulting in the passage of large, hard lumps. The one who drank the condensed milk suffered most in this respect and passed one lump about 2 inches in diameter, light yellow and very hard. They had no difficulty voiding. Urinalyses were negative. Blood counts taken 6 days after the rescue indicated that all had a moderate secondary anemia (70 percent) but no other abnormality.

TREATMENT

The diet consisted of fluids of all kinds for the first 2 days; tea coffee, lemonade with sugar, hot soups, pineapple juice, etc. They were given a soft diet on the second day and a full diet the last 2 days on the ship. They were not nauseated, nor did they have pain in their stomachs at any time. Thiamine chloride and codliver oil were given three times a day. Sodium salicylate, 10 grains, was given four times a day for pain in the feet. Phenobarbital, 1½ grains, was given at night. The pustular condition of the skin cleared up rapidly after opening the pustules and washing frequently with soap and water. Petrolatum was applied to the extremities and they were then wrapped in cotton. Petrolatum seemed to give more relief than either cold cream or lanolin. However, the men were more comfortable when the feet were exposed to the air. All ulcerated areas were cleaned daily with distilled water and were dressed with a small amount of petrolatum on sterile gauze. The lower legs and feet were then lightly bandaged and were protected by thick wrappings of cotton. In the hospital, the two ulcerated areas on the feet were exposed to the air under a cradle. They healed nicely and at the end of 3 weeks were the size of a half dollar. They were all given large doses of all of the vitamins while in the hospital, and under this treatment the apthous stomatitis cleared up in 10 days. They regained their strength rapidly and 1 week after the rescue, three of them were permitted to walk around within the limits of the hospital.

CONCLUSIONS

1. Food should not be put in bulk in large metal tanks but should be put in small hermetically sealed cans and then put in large containers. Screw caps with rubber gaskets in metal tanks will leak after being opened the first time.

2. The same may be said of water. Small hermetically sealed cans of water for individual use should be used. This allows for easy, individual daily rationing without any danger of spoilage by sea water. Storage can be made under water if necessary.

3. Muscle wasting occurred in 4 out of 5 cases. Canned milk definitely prevented muscle wasting in the one case. Canned milk is a concentrated food providing adequate protein and used alone will sustain life for a long time. It is staple and commercially is available in hermetically sealed cans that may be stored in any nook or corner of a raft.

4. A small amount of fruit juices should be provided in hermetically sealed cans to be used at intervals as an adjunct or to take the place of daily water or milk rations. This will vary the diet, which is important, and at the same time it is a source of liquids, carbohydrates, a small amount of vitamins, and may tend to have a slight laxative effect.

5. The survivor who developed the severe stomatitis showed much more muscle wasting than the others. This condition was due to a combination of malnutrition and avitaminosis. Mixed concentrated vitamin tablets should be included in the daily ration.

6. Almost any type of oil or grease acts as a skin protective to exposure and immersion. Liquid petrolatum is the oil of choice and at least 2 quart tins should be included in each boat box. All survivors suffered severe constipation while on the raft. Thus liquid petrolatum can serve a dual purpose, being applied externally as a gentle massage for the feet and legs during exposure, and may be taken internally as a lubricant.

7. Immersion is a definite factor contributing toward casualties among survivors, but what is more important is immersion plus friction, or immersion plus chronic irritation as proved in one of these cases. The affected feet should be handled very gently, kept clean, and all pressure points protected with thick wrappings of cotton.

8. The salt and water balance of the body probably plays a very important part in the progress of this type of case. Following dehydration, drinking of pure sea water in adequate amounts for a period of 2 days causes one to become quite irrational and is definitely a contributing cause of death. One survivor drank copious quantities of sea water the last 2 days on the raft. The night before being rescued he became quite irrational and had to be dissuaded from the desire to cut his own wrists. After being rescued, he was fed an abundance of fluids, and in 2 days' time both his ankles and lower legs became markedly edematous. This edema, however, cleared up completely by the time he left the ship 3 days later although he was still drinking a considerable quantity of fluids. His urinalyses were negative. Following dehydration, drinking copious quantities of pure sea water causes the blood and the interstitial fluid to become hypertonic. Therefore, if this condition is followed by drinking an abundance of fresh water, an interstitial edema will follow and this edema will persist until the excess amount of salt is washed out of

the interstitial fluid as proved in this instance. However, if this condition is not followed by drinking an abundance of fresh water, but by drinking more salt water, the concentration of salt within these two fluid structures (i. e. the blood and the interstitial fluid) will become progressively greater until the integrity of the intracellular fluid is threatened. This is probably the turning point, and if the condition is not quickly relieved, mental deterioration and death soon follow.

9. It will be noted that the survivors from the raft when drinking their daily water ration always added a small amount of salt water to the ration. I have found that in mixing pure sea water with fresh water in the proportion of 1:6 no salty taste is discernible. In the proportion of 1:5, a slight salty taste is evident. Some authorities state that thirst associated with dehydration is probably an index of salt lack as well as fluid lack. They further state that if dehydration is profound, the ingestion of water without salt does not satiate. There is no doubt that these survivors lost a considerable quantity of salt each day via the kidneys and by sweating, and also they, day by day, became progressively more dehydrated. Thus adding small amounts of salt water to the daily ration of fresh water so that the potability of the water is not changed seems to be an excellent idea as it will make the water last longer, will tend to keep the blood chlorides at a normal level, and should have a tendency to satiate thirst.

NIGHT BLINDNESS, IMPROVEMENT WITH VITAMIN D^{1 2}

INCLUDING THE EXPERIMENTAL PRODUCTION OF RETINITIS PIGMENTOSA AND ITS TREATMENT IN HUMANS WITH VITAMIN D

By ARTHUR ALEXANDER KNAPP, Commander, Medical Corps, United States Naval Reserve

Night blindness—variously called nyctalopia and (incorrectly) hemeralopia—is a pathological disturbance of the light sense. It may be brought on by a local ocular lesion or by a systemic disorder. Generally, the systemic type is regarded as a manifestation of vitamin-A deficiency. It is so commonly linked with defective vitamin-A metabolism that several instruments for determining dark adaptation have been invented, instruments presumably giving a positive diagnosis of deficiency in vitamin A. Actually, however, vitamin D also is vitally concerned in night blindness.

Of all ocular conditions giving rise to nyctalopia, retinitis pigmentosa stands in the forefront. Fortunately, it is a rare disease.

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² From the Hospital for Special Surgery, New York City.

Several years ago Blackberg and the author did some experimental work on pups (1). The study was carried on at Columbia University, Department of Pharmacology. Three series of the animals were fed diets deficient in vitamin D and low in calcium, over a period of 7 months. Controls were maintained. The pups were examined frequently. Much ocular pathology was discovered. Amongst the findings, those seen in the retinas were highly significant.

Consistently, we noticed changes which were comparable to those lesions seen in retinitis pigmentosa in the human. Primarily, the retina of the dog differs from the human in that it shows a tapetum cellulosum, which is a multicolored, concentrated pigmented area spreading over the superior half of the fundus oculi, its inferior border being just above the level of the superior disc margin.

Below this sharply demarcated area, the retina shows an almost uniform pink color. In addition, there is an irregular nerve head, from which the arterioles and venules emerge. These vessels reveal a similar relationship in caliber to that of the human, two to three.

After the animals had been on the diet for a few weeks, the following changes were noted: Several small, scattered areas of pigment over the inferior half of the fundus—either a pigment migration or a newly formed pigment—having a similar color to some portions of the tapetum cellulosum; pallor of the disc; and slight narrowing and increased light reflex of the arterioles.

While the picture is not an exact reproduction of human retinitis pigmentosa, it must be borne in mind that fundamentally we are dealing with two different species, with entirely dissimilar anatomical structures. Nevertheless, considering the basic clinical pathology of the retinas, in the vitamin-D deficient dogs and in the humans afflicted with the disease, may we not draw the conclusion that retinitis pigmentosa was induced in these animals?

Furthermore, retinitis pigmentosa in the human generally is complicated by a posterior cortical cataract. In every one of our animals, a cataract developed.

To evaluate the suggested therapy in this condition, nine patients suffering from retinitis pigmentosa were studied over a period of 2 months to 7 years. As a matter of routine, each day they received a minimum of 60 drops of viosterol (13,860 international units) and tablets containing (in milligrams) calcium 140, phosphorus 83, copper 0.05, magnesium 2.8, sodium and potassium 5 each.

If a patient took a quart of milk daily, only one tablet was given. For each glass less than a quart, two tablets were added; so that if no milk was taken, nine tablets were advised. It is well to remember that at least one gram of available calcium is indicated. The tablets were taken before breakfast, since it has been found that they

are best absorbed in an acid medium. The viosterol was taken after breakfast. No other change was made in the regimen.

These patients were examined as often as was deemed necessary. The fundi, fields and blind spots, as well as the vision, were checked. A detailed report will be published shortly. It may be stated here that there was definite improvement, chiefly subjective.

All the patients complained bitterly of night blindness. They had progressed to the moderate or advanced stage. After they had been on the vitamin D and calcium supplement for approximately 7 weeks, they noticed decided improvement in their vision at night. Many objects, at varying distances, which were formerly obscure to them in the evening, now were revealed. One patient, a middle-aged woman, with advanced retinitis pigmentosa, for years had not ventured forth alone in the street after sundown. Following the above therapy, unhesitatingly she set out from her home after dark.

Aside from this definite change in nyctalopia, five patients revealed corresponding objective improvement of their nerve heads. Prior to this study these persons showed the characteristic apple-jelly pallor of the disease. During the course of therapy the discs, for a time, took on a pink color, and in two instances, became erythematous. In three cases, there was a seeming change in caliber of the arterioles. It appeared that there was an increase in the width of these vessels.

Another condition often complicated by night blindness is myopia. In a series of 93 patients, suffering from various degrees of myopia ranging from the very mild to the marked, progressive type—the majority in the latter class—64 complained of poor vision in reduced illumination. As routine treatment, these 64 received a similar dosage of viosterol and calcium. With some, however, the vitamin-D dose was increased to 200 drops daily. Otherwise, their routine remained the same.

This group was under observation for periods ranging from 6 to 27 months, during which time they were checked at least once each month. In 20 cases, or about 31 percent of this series, there was an actual reduction of the myopia. Casts of the anterior segment of many eyes and, in one instance, a fundus photograph taken in the posterior segment, were made before and after treatment, under identical conditions. Beyond question, it was proved that the eyeball, in both its anterior and posterior segments, may shrink following the administration of vitamin D and calcium (2).

Of these 64 persons suffering from poor vision at night, 48 noticed distinct improvement in respect to their nyctalopia, in no way dependent upon their myopic status. As a rule, several weeks elapsed before clinical improvement was definitely seen. The majority of those patients whose myopia was reduced, spoke of their greater ability to see after nightfall. Others showed better night vision when their

myopia was stationary, or even in the presence of an increase of their nearsightedness. Sixteen apparently remained the same. They had not noticed any particular difference. Those who improved pointed out that objects formerly invisible, or indistinguishable in the dark, now could be seen—persons, curbstones, and signs at night. After they entered a darkened cinema, adaptation to darkness came on more rapidly. They were better able to see in the dark after having had their eyes exposed to sunshine or bright electric light. Persons and theater seats were made out more readily.

It should be stressed, however, that an additional factor may play a part in this new-found vision in several of these subjects. In previous articles (2) (3) (4), I have shown that the central vision of myopes may become more acute after they have received vitamin D and calcium. This greater acuity is manifest with and without the use of glasses. Therefore, how much of the increased night sight in some of these patients is due to the vitamin-D complex factor of the nyctalopia treatment, and how much is due to increased visual acuity, will be determined by further research. But, it is to be remembered that these patients saw better in the dark, and so much so, that it was out of all proportion to the increased visual acuity.

During the treatment of both the cases of retinitis pigmentosa and the myopes, evidences of toxicity were watched for constantly. Seldom did a toxic sign develop—a mild rash, nausea, vomiting or constipation. These symptoms disappeared shortly after the medication was stopped or reduced.

To determine the possible toxic effects of this treatment certain pertinent examinations were made on several of the patients in each group: General medical, ophthalmoscopic, gastric contents, roentgen-ray of heart and kidney, urinalysis, and determinations of the calcium, phosphorus and protein in the blood.

General medical examinations failed to reveal any pathology referable to vitamin D. Gastric hypoacidity was frequently found. Heart and kidney x-rays showed both organs to be normal. The urines were essentially negative. Calcium, phosphorus and serum protein in the blood always were within normal limits. Ophthalmoscopically, the check-ups possibly were of greater value. For, in work to be published shortly (5), Blackberg and I have shown that when all other clinical evidence of deficiency diseases is absent, changes in the retinal vascular system may be seen. At no time, however, during the observation of these patients did arteriolar sclerosis develop. In those patients who revealed sclerosis before beginning this therapy, no change in the process could be made out.

On the other hand, hyperopia never has been shown to have a direct relationship to night blindness. Still, a few hyperopes received the viosterol and the mineral tablets. The number of patients observed

and the results obtained are too meager to permit of a convincing conclusion.

CONCLUSIONS

Night blindness in the human may be caused by vitamin-D deficiency. Where this is so, the administration of vitamin D and calcium in sufficient dosage may remove this defect to a considerable degree.

Toxicity of these preparations, in the doses used, is negligible. In the light of our present knowledge the prescribed amount of vitamin D is small. The calcium dosage utilized is within physiological limits.

Retinitis pigmentosa—a comparable condition to that of humans—has been produced in dogs.

In the human, vitamin D and calcium have proved of value in treatment of this primary pathology of the retina. These night-blind patients were improved considerably. They were better able to see in the dark. In some cases the characteristic apple-jelly pallor of the optic nerve, for a time changed to a normal pink or erythematous disc.

The night-blindness of myopes often may be helped by prescribing these medications. Reduction of myopia was found in almost one third of this series.

Night blindness may be caused by a deficiency of at least two vitamins, A and D.

Where it is desirable to improve the night vision of the patient, particularly in the armed forces, it would be well to fortify the diet with comparatively large doses of vitamins A and D.

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THE ADMINISTRATION OF HELIUM AND OXYGEN MIXTURES IN THE TREATMENT OF DISABLING EAR SYMPTOMS CAUSED BY CHANGES IN ATMOSPHERIC PRESSURE ¹

By I. J. THORNE, Lieutenant, Medical Corps, United States Naval Reserve

The extreme importance of combatting disabling ear symptoms caused by variation in atmospheric pressure cannot be too strongly emphasized. This is especially true where military aviation is concerned involving high-altitude flying and dive bombing. In this present emergency, every pilot kept in the air will bring the war nearer its successful conclusion. Therefore any prophylactic measure that can be instituted which promises to be of value in combatting disabling symptoms referable to the ear, in aviation, deserves a fair trial.

Compressed air personnel and deep sea divers refer to these disabling symptoms as "ear block." The similar condition which occurs in aviation flight personnel is referred to as *aero-otitis media*. This condition was first described by Armstrong and Heim (1) in 1937 in detail. They observed the condition closely in aircraft pilots and introduced the term *aero-otitis media*. This condition is substantially an acute or chronic inflammation of the middle ear. It arises because of a pressure differential between the air in the atmosphere and that in the tympanic cavity. It is brought on usually by changes in atmospheric pressure such as accompany altitude changes in aeroplane flights. It is characterized by pain, loss of hearing, tinnitus, and acute inflammation with bulging or retraction of the tympanum. This syndrome is similar to the changes in the ear observed in diving and compressed air personnel suffering with ear block. The methods of treatment and prophylaxis described in this article may therefore be applied to aviation personnel afflicted with *aero-otitis media*.

The results reported were obtained by the author at the Norfolk Navy Yard, Portsmouth, Va., in the capacity of supervising physician of the compressed-air medical station of the Dry Dock Associates, who were the contractors for the building of the drydock. Compressed air was utilized to sink the caissons for the pump-well stations and in the boring of the water tunnels connecting the drydocks with pump-well station.

The compressed-air personnel consisted of caisson workers, contractors, engineers, naval inspection engineers, compressed-air superintendents, and lock tenders for manipulation of the air valves on

¹ Received for publication September 14, 1942.

the compression and decompression chambers. The compressed-air medical station personnel was composed of a supervising physician and two assistants who were previously trained and experienced in caisson operations and in the treatment of compressed air illness or the "bends."

Because of the urgency and necessity of completing the construction project as quickly as possible, the compressed-air operations were placed on a 24-hour schedule. Therefore, the compressed-air medical station was placed on a similar basis.

The environment in which the compressed air personnel carried out their operations was very cool and damp. These conditions coupled with the extreme inclemency of the weather during the operating months of February, March, and April, 1942, predisposed the entire compressed-air personnel to upper respiratory infections. The common cold was extremely prevalent.

As a result of the prevalence of upper respiratory infections, the occurrence of ear block as a secondary complication amongst the personnel, presented a serious problem from the point of view of loss of valuable working time. This threatened the completion of the construction project in the required time. Much valuable time was also lost when a caisson worker was seized with an ear block while "locking into" the compression chamber. This necessitated the shutting off of the incoming compressed air while the afflicted individual was being removed from the main compression chamber through the auxiliary entrance. During this process the other workers in the chamber had to wait until this procedure was completed, losing valuable time thereby. When the compressed air was turned on again, this fluctuation in pressure frequently precipitated an attack of ear block in another individual, with consequent further loss of time. Prior to the institution of the helium oxygen inhalation treatment, a compressed air worker was of necessity precluded from carrying on his operations underground for a period varying from 7 to 14 days depending on the severity of his upper respiratory infection and the length of time necessary for its subsidence. Occasionally an individual would try to "force" himself through the compression chamber despite intense pain from ear block, to save the loss of a day's wages. This often resulted in rupture of the ear drum because of the high-pressure differential of the surrounding atmosphere. A pressure differential of 5 pounds above atmospheric is sufficient to produce rupture of the tympanum. Once the drum has ruptured, secondary infection may follow with resultant purulent otitis media and the exclusion of the individual from further work in compressed air for a long period of time.

On the basis of previous reports on the possible efficacy of helium and oxygen inhalations to relieve incipient ear block, the author ob-

tained the permission of officials of the Norfolk Navy Yard and the contractors to give this method of treatment a trial. The favorable results obtained justified its use, as will be reported later in this article.

NORMAL AND ABNORMAL PHYSIOLOGY OF THE EUSTACHIAN TUBE AND THE
MECHANISM OF THE PRODUCTION OF EAR BLOCK AND AERO-OTTIS MEDIA

The eustachian tube is a trumpet-shaped organ connecting the middle ear with the posterior part of the pharynx. The middle ear is separated from the external ear at its outer end by a membranous drum known as the tympanic membrane or ear drum. The eustachian tube acts normally as a ventilating and drainage canal for the middle ear and is usually in a collapsed state. By means of contraction of the dilator muscles with which it is supplied, the tube can be made to open. This occurs unconsciously in acts of yawning or swallowing, allowing the air pressure on either side of the ear drum to become equalized, permitting normal functioning of the ear.

The extreme delicacy of the mucous membrane lining the upper respiratory passages is well known to physicians. Mild inflammation and congestion without symptoms are not uncommon in apparently normal healthy individuals. Equalization of pressure under normal conditions between the eustachian tube, middle ear, and the surrounding atmosphere is usually obtained with little difficulty and without conscious effort. However, should atmospheric pressure be suddenly increased, it is transmitted to the inner opening of the eustachian tube. It is conceivable that a valvelike effect might be caused by eversion of the mucous membrane, thus mechanically blocking the tube and preventing equalization of pressure setting the stage for the production of ear block. The congestive swelling of the mucous membrane and the presence of thick, tenacious secretion around the inner opening of the tube favor the establishment of this mechanical block. The result is an inability of the atmospheric pressure to equalize on either side of the drum membrane. The predominant symptom is severe pain caused by a greater pressure on the outside of the drum than on the inside. This produces a retraction of the drumhead which can be confirmed by otoscopic examination. The pain will continue in severity until equalization of pressure takes place or if increase of pressure continues, the ear drum ruptures. Paradoxically, relief from pain is obtained when the drum ruptures. Under conditions of ruptured ear drum, the external canal and the eustachian tube become one continual passageway with pressure consequently equal throughout its length. If the increase in pressure should cease before rupture of the drum, the negative pressure in the middle ear and eustachian tube produces a suctionlike effect causing the walls of the eustachian tube to become closely approximated. Engorgement of blood vessels in the vicinity

occurs with the exudation of serum. Pain, tinnitus, and loss of hearing occur. The severity of these symptoms depends on the length of time the ear block is allowed to continue and the amount of pressure differential existing. At this point otoscopic examination of the drum will reveal the signs of acute inflammation (acute catarrhal otitis media) with retraction of the ear drum and a pink to angry red appearance of the tympanum which is characteristic of this condition. If the process continues long enough to cause firm adhesions of the walls of the eustachian tube, as usually occurs in frank upper respiratory infections, it may be impossible to break the ear block until the upper respiratory infection has cleared. In the author's series of cases, this has required a resting period of 7 to 14 days.

In aerial flight from ground level to high altitudes a similar condition occurs. However, the pressure differentials under these circumstances are reversed. There is less pressure externally than internally. Consequently air in the middle ear and eustachian tube, if trapped, undergoes expansion due to the decrease in pressure and the operation of the law of expansion of gases under decrease of pressure. The normal anatomy of the eustachian tube, however, facilitates exit of air and in the majority of cases the tube opens and air is emitted, thus allowing pressure equalization to occur on either side of the drum membrane. On return to the ground level, should the eustachian tube fail to open to permit pressure equalization, there results a reverse of the conditions described above, similar to ear block. There is now a decrease in pressure in the middle ear and eustachian tube (suction effect). If this block is not relieved, a train of events occurs. There is engorgement of blood vessels in the vicinity, exudation of serum, pain, tinnitus, loss of hearing, and acute catarrhal inflammation of the drum membrane producing the syndrome of aero-otitis media.

In high-altitude flights involving the respiration of 100 percent oxygen, the upper respiratory passages, including the eustachian tube, become filled with pure oxygen gas. Should the eustachian tube become blocked on return to ground level or after the removal of the oxygen mask, slow absorption of the oxygen trapped in the tube will produce a negative pressure with the resultant production of the aero-otitis media syndrome. Frequently a pilot will awaken after a sleep complaining of symptoms referable to the ear following a high-altitude oxygen flight previous to his retiring. Normally the process of yawning and swallowing will serve to open the pharyngeal end of the eustachian tubes with consequent relief obtained by equalization of pressure on either side of the ear drum. However, should the eustachian tube fail to open during sleep the process may continue on to a full-blown aero-otitis media with temporary grounding of the individual until the process subsides. This may require a rest period of from 7 to 14 days. Individuals who have difficulty with their ears

when undergoing changes in atmospheric pressure in the form of repeated attacks of ear block, should be examined for other possible etiological factors. With a normal appearing mucous membrane of the nose and throat, as evidenced by physical examination and freedom from symptoms, the possibility of obstruction to the pharyngeal end of the tube by redundant lymphoid tissue should be borne in mind. Other factors to be considered are abnormal congenital angulation of the tubes, or stenosis and adhesions from previous infection of the nose and throat.

The loss of efficiency of aviation personnel as a result of disabling ear symptoms caused by changes in atmospheric pressure, especially those of pain, tinnitus and loss of hearing is extremely important because of the safety of the plane, its personnel and the successful fulfillment of its mission during aerial operations.

METHODS OF INSTITUTING TREATMENTS

To ascertain the efficacy of helium and oxygen as a form of treatment and to prove its value, the cases of ear block treated were divided into two groups. One group was given a course of helium oxygen inhalation. The individual sustaining an ear block was surveyed out of the compression chamber through the auxiliary entrance and brought directly to the medical station, a brief history was obtained and an examination of the nose and throat was made. Following this, both ears were inspected with the otoscope. Examination of the nose and throat in all cases showed mild to severely acute inflammation of the mucous membranes. Examination of the ear drum revealed retraction of the drumhead, decrease in size of the light reflex, increased prominence of the short process of the malleus, a shortening and more horizontal appearance of the handle, and a pink to angry red appearance of the ear drum.

The following routine was carried out in the group of cases treated with nasal drops. With the patient lying on an examining table with the head extending over the end of the table in hyperextension, 10 drops of a $\frac{1}{2}$ percent solution of neosynephrin hydrochloride were instilled in each nostril. While in this position the head was rotated slowly from side to side. He was then removed from the table and seated on a stool with his head hanging down between the knees, rotating his head from side to side while in this position. These maneuvers made certain that the fluid reached all the available tissues and spaces in the nasopharynx. The maximum shrinking effect was thus obtained. The patient was then given a test in the medical compression and decompression chamber under compressed air to ascertain the effect of the medication. If the individual did not block after the application of a positive pressure of 10 pounds (atmospheric plus 10), treatment was considered to have been successful and he was sent to the main com-

pression chamber to resume work in compressed air. If the ear block recurred in the medical lock, the incoming compressed air was immediately shut off. The individual was assigned to sick quarters in the barracks. He was given treatment for his upper respiratory infection and told to return to the medical station at least three times a day for the nasal drop treatment. A test in the medical decompression chamber followed each nasal treatment.

TABLE 1.—*Summary of results obtained*

	Number of cases of "ear block"	Number of cures	Number of failures	Man days of labor saved	Percent of failures	Percent of cures
Nasal drop treatment.....	153	64	89	213 $\frac{1}{2}$	58	42
Helium-oxygen treatment.....	153	141	12	470 $\frac{1}{2}$	8	92
Total.....	306	205	101	683 $\frac{3}{4}$		

The group given the helium oxygen treatment received an inhalation of the mixed gases for a period of 3 to 5 minutes. The mixture contained helium 80 percent and oxygen 20 percent. The inhalation was given through a demand type of nose and mouth mask which connected to an expansible breathing bag. The mask was made to fit snugly over the nose and mouth by means of a softly inflated rubber device. The expired air was led off from the mask by means of an expiration valve. A test in the medical decompression chamber followed each inhalation. If the ear block was relieved successfully, the patient was removed from the chamber. He was given an inhalation of the mixed gases for 2 more minutes and returned to the main compression chamber for work in compressed air.

ACTION OF HELIUM OXYGEN MIXTURE IN COMBATTING EAR BLOCK

The exact mode of action of the helium oxygen mixture in the relief of ear block is still debatable. Lovelace and Mayo (3) in February 1939 reported the successful treatment of aero-otitis media with a mixture of helium and oxygen. They attributed their results to the greater lightness and diffusibility of the helium molecule as compared to nitrogen. It is possible, therefore, that in a respirable mixture of helium and oxygen, the helium would diffuse through the accessory nasal sinuses and ostia of the eustachian tubes more rapidly than would the nitrogen of the air. Therefore equalization of pressure between the middle ear and the atmosphere should occur with greater speed and facility. Helium is one of the lightest inflammable gases in existence. Its rate of diffusion is 2.7 times that of nitrogen. The speeds are 1.202 km./sec. for helium and 0.453 km./sec. for nitrogen (4). The possibility of helium acting directly on the mucous membranes of the upper respiratory tract and eustachian tubes must also

be borne in mind. Helium may also have a direct effect upon the dilator muscles of the tubes.

TABLE 2.—*Further analysis of cures and failures from table 1*

	Number of cases	Number of treatments	Time lost
Nasal drop treatment:			
Cures.....	32	1.....	None.
	21	2.....	3 hours.
	11	3.....	6 hours.
Failures.....	54	3 per day.....	7 days.
	27	do.....	11 days.
	9	do.....	14 days.
Helium-oxygen treatment:			
Cures.....	141	1.....	None.
	7	1 per day.....	7 days.
Failures.....	5	do.....	9 days.
	2	do.....	14 days.

1. The results of the treatment of 306 cases of ear block in compressed air personnel at the Norfolk Navy Yard, Portsmouth, Va., during the construction of the drydocks is reported in tables 1 and 2.

2. In order to ascertain the efficacy of the helium oxygen mixture in relieving ear block the 306 cases were equally divided. One hundred and fifty-three cases were given a course of treatment with $\frac{1}{2}$ percent neosynephrin hydrochloride nose drops instilled in each nostril. One hundred and fifty-three cases were given an inhalation mixture of helium 80 percent and oxygen 20 percent for 3 to 5 minutes.

3. A trial test in the medical decompression chamber was given after every treatment to ascertain its success or failure in the relief of ear block. The results were recorded.

4. By the institution of treatment for ear block a total of $683\frac{2}{3}$ man-days of labor were saved by the combined methods.² The nasal-drop method of treatment yielded $213\frac{1}{3}$ days. The helium-oxygen inhalation method yielded $470\frac{1}{3}$ man-days of labor saved.³

CONCLUSIONS

In this series, the results obtained from the use of helium oxygen inhalations as compared to the nasal-drop method of treatment is prima facie evidence of its efficacy.

The mechanism of the production of ear block in compressed air personnel appears to be essentially similar to that occurring in aviation personnel. Therefore, the introduction of helium-oxygen inhalation mixtures in the treatment of disabling ear symptoms in aviation personnel is suggested particularly in high-altitude fliers and dive bombers.

² A man-day of labor is equivalent to 1 man working for 24 hours.

³ These figures were arrived at by obtaining the average of the number of days necessary for convalescence from a full blown aero-otitis media. This average was found to be approximately 10 days.

There appears to be a definite relationship to the occurrence of upper respiratory infection and the onset of ear block. Secondary infection of the eustachian tubes from the upper respiratory infection causes adhesions of the walls of the eustachian tubes. The degree of firmness of these adhesions is the deciding factor in whether or not relief will be obtained with the inhalation method of treatment. It was noted that in this series of cases ear block disappeared simultaneously with disappearance of inflammatory signs in the ear, nose, and throat.

The essential importance of instituting helium oxygen inhalation as quickly as possible after the onset of symptoms of ear block is hereby stressed because of the condition mentioned above. Once firm adhesions of the walls of the eustachian tubes have formed, inhalation treatment will be unsuccessful.

The paramount importance of keeping aviation personnel free from upper respiratory infections and treating those that occur immediately is obvious. This precaution in itself will reduce the percentage of ear blocks.

The possibility of the value of helium oxygen inhalations as a prophylactic and preventive measure for ear block in aviation personnel is hereby presented for consideration.

It was shown from this series of cases that a period of 7 to 14 days was required for convalescence from acute catarrhal otitis media (aero-otitis media) as a result of ear block unsuccessfully treated.

If a corresponding number of flying hours could be saved in a corresponding number of aviation personnel, by the introduction of helium oxygen inhalations, much will be gained thereby.

Acknowledgment.—The author gratefully appreciates the cooperation offered in the carrying out of the above-described treatments. In this regard he wishes to express his sincere thanks to the Commandant of the Norfolk Navy Yard, Portsmouth, Va., to all the officers of the Public Works Section and to the Dry Dock Associates through whose combined efforts the necessary helium and oxygen were made available for use. To his technical assistants, wherever they may be, he wishes to express his appreciation for their unselfish efforts in aiding in the successful completion of this task and for exhibiting an esprit de corps far above and beyond the call of duty.

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LEAD HAZARD OCCURRING DURING REPAIR OF A BURNED SHIP¹

By WALTER E. FLEISCHER, Lieutenant, Medical Corps, United States Naval Reserve, and FREDERICK J. VILES, Ensign, H-V(S), United States Naval Reserve.

Following a recent, very damaging fire on a large troop transport, the workmen employed on its repairs complained that they were exposed to a large amount of irritating dust.

Investigation showed that, as a result of the fire, there was considerable debris lying around in the ship compartments, which had to be removed. This debris consisted of:

1. Layers of fiberglas insulation, part of which was still on the partitions and was being ripped down and part of which had been torn down incident to fighting the fire.
2. Ash from the combustion of furniture, hangings, paint, wire, insulation, woodwork, plumbing fixtures, etc.
3. Miscellaneous metal scrap.

This debris was shoveled into piles, loaded into wheel-barrows, carried to dumping platforms inside the ship and thence dumped and shoveled out through port holes. The port holes were connected with chutes, and the debris was thus conveyed to the dock. The location of the ship was such that it was unprotected from the wind and frequent gusts of wind blew debris dust back through the port holes into the ship and swirled it around inside the compartments.

Dust samples of the air were taken with the Greenburg-Smith impinger and the particles counted in a Neubauer bright-line counting chamber. These samples were taken at the following locations:

1. At the edge of the former dining room, midway between the shoveling and dumping operations where the air was relatively quiet and not markedly affected by gusts of wind.
2. At the site where the debris was scraped together into piles and then shoveled into wheelbarrows.
3. On the dumping platform adjacent to the portholes connected to chutes.

All these samples were taken inside the ship on the port side of "C" deck, frames 108 and 128 and in an area where a considerable number of men were working.

Dust counts were calculated with the formula:

$$\frac{N \times V}{4 \times T} = \text{Number of million particles per cubic feet of air.}$$

Where:

N = Number of particles counted per 0.004 cu. mm.

V = Dilution volume of impinger sample in cc.

T = Time of sampling in minutes at rate of 1 cubic foot per minute.

¹ Received for publication December 10, 1942.

The following table gives the results of the dust sampling:

TABLE 1.—*Dust samples from compartment where men were working*

Description of sample	Rate of sampling	Time of sampling	Volume of air sampled	Million particles per cubic feet of air
	<i>Cubic feet per minute</i>	<i>Minutes</i>	<i>Cubic feet</i>	
Quiet air.....	1	15	15	4.2
Shoveling operation.....	1	15	15	14.9
Dumping operation.....	1	5	5	70.0

At this stage of the investigation we recommended that the workmen exposed to this dust wear respirators affording protection against pneumoconiosis-producing and nuisance dusts. However it occurred to us that the intense heat and reactions during and after the fire upon such materials as paint, cables, pipes, plumbing, etc., might have produced dust with a high lead content.

Preliminary lead analyses demonstrated the following:

1. Paint scales were strongly positive for lead using the microscopic technic of Chamot and Mason with the formation of crystals of lead nitrate and lead iodide as the criteria.
2. Debris samples from wheelbarrow loads and the dumping platform were strongly positive for lead using the same technic.
3. Quantitative tests on these same debris samples were done with Fairhall's chromate method and found to contain 9 percent lead. The moisture content of this debris was only 2 percent and was disregarded.

However it remained to be shown how much of this lead in the debris dust was suspended in the air, thereby exposing the workmen to a lead hazard. For even though lead might be found in debris dust samples taken from wheelbarrow loads, dumping platforms, etc., it was necessary to determine if such lead particles were sufficiently small to remain suspended in air for a considerable period of time.

Therefore we suspended our original debris samples in a dust chamber and made dust counts and lead analyses of these suspended particles. With the stirring fan running continuously to keep the dust cloud distributed uniformly throughout the dust chamber, a 20-minute dust sample was taken with the impinger. To determine further whether the lead particles settled out slowly or rapidly, a second dust sample was taken immediately after the first, for a period of 36 minutes with the fan shut off. In each case the dust particles were counted and lead analyses run on these impinger samples using the diphenylthiocarbozone (dithiozone) colorimetric technic. The lead content of the second set was slightly higher than the first set, indicating that the lead particles did not settle out more rapidly but remained suspended longer than the rest of the particles.

TABLE 2.—*Dust samples from dust chamber*

Sample	Time of sampling	Millions of particles per cubic foot	Micrograms of lead	Milligrams lead per 10 cubic meters of air	Milligrams of lead per 10 cubic meters per million particles per cubic foot of air
	<i>Minutes</i>				
No. 1 (fan on).....	20	49.0	864	15.3	0.312
No. 2 (fan off).....	36	8.7	420	4.12	.474

These lead concentrations were sufficiently close so that an average figure of 0.4 was used and applied to the original dust concentrations obtained to determine the lead concentrations to which the workmen were exposed.

TABLE 3

Description of sample	Millions of dust particles per cubic foot of air	Milligrams of lead per 10 cubic meters per million particles per cubic foot	Milligrams of lead per 10 cubic meters of air breathed by workmen
Quiet air.....	4.2	0.4	1.68
Shoveling operation.....	14.9	.4	5.96
Dumping operation.....	70.0	.4	28.00

SUMMARY AND RECOMMENDATIONS

These concentrations are all above the threshold of 1.5 milligrams of lead per 10 cubic meters of air. It is obvious that under these conditions respirators which afford protection against toxic dusts should be used. We therefore recommend that respirators be used which are approved for pneumoconiosis-producing and toxic dusts.

Undoubtedly in the future there will be repairs made to other burned ships. In such cases where facilities are not available for making lead analyses on the dust, it is recommended that the workmen be equipped with the previously mentioned respirators.

Acknowledgment is made to Captain H. E. Jenkins (MC) USN, Medical Officer, Boston Navy Yard, for his cooperation and for affording us the opportunity to pursue this investigation, and to the Liberty Mutual Insurance Co. for allowing us the privilege of using their dust chamber.

RUPTURED INTERVERTEBRAL DISCS ¹

By D. H. WERDEN, Lieutenant Commander, Medical Corps, United States Naval Reserve

Intraspinal protusion of an injured intervertebral disc has recently been well established as the cause of pain in a major portion of cases

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of so-called low back pain with sciatica. Two recent advances have made this subject of particular importance in the treatment of patients in the United States Naval Service: First, the recognition and diagnosis of a protruded disc on the basis of the clinical findings alone without the use of contrast media; and, second, the surgical removal of the protruded portion of the disc by a relatively simple and nondisabling operation. These advances have permitted the separation of those cases having a specific cause and treatment from that large group of cases with indefinite and uncertain etiology of back, hip, and leg pains. As a result the number of sick days are decreased and the amount of partial and permanent disability is materially lessened.

The importance of this subject relative to the naval service is shown by the following: In 1940 (1) there were 676 new admissions to the sick list with a total of 17,853 sick days for the large group of cases with back, hip, and leg pains variously diagnosed as myositis, sprain, strain, intraspinal injury (not fractures), and sciatic neuritis. Of these, 108 were diagnosed as neuritis, sciatic, with a total of 5,039 sick days, an average of 46.6 sick days per admission. During this period, there was only one admission having a definite diagnosis of rupture, traumatic, fibrocartilage, intervertebral disc.² By comparison, for approximately 1 year following February 24, 1941, in the United States Naval Hospital, San Diego, Calif., 23 patients were proven by operation to have had ruptured disc causing a low back and sciatic syndrome. In an additional 10 patients this diagnosis was made, but for one reason or another (usually the fact of its existence prior to enlistment), these were not treated or proved by operation. It is therefore apparent that heretofore many cases of protruded discs in the service were not recognized as such. With the expansion of the naval forces in 1941 and 1942, the number of cases of this type will be markedly increased.

Forty-three surgically treated cases of intraspinal ruptured discs at the fourth or fifth lumbar level form the basis of this report. These have been seen during the past 3 years, 26 among naval personnel and 17 in civilian practice.

Prior to 1930 protruded discs were occasionally recognized as such, and reported by Adson, 1925 (2), Stookey, 1928 (3) and Dandy, 1929 (4), but peculiarly enough most of the reports concerned those discs found in cervical region and were encountered while exploring for spinal cord tumors. Since 1934 Mixter and Barr (5), Hampton and Robinson (6), Love and Camp (7), Naffziger, Inman, and Saunders (8), and many others since 1939 have shown that 95 percent of discs occur at the fourth or fifth lumbar level, causing not cord symptoms but rather single-nerve root compression and sciatic radiation of pain. More recently Craig and Walsh (9) described

² Official nomenclature.

recurrent nerve filaments in the posterior spinal ligament. They have postulated that in the early stages of protrusion, pressure exerted backward against the posterior spinal ligament and its nerve filaments accounts for localized backache and pain, while on farther protrusion (usually at a later date), a spinal nerve root is compressed, distorted and fixed, this resulting in sciatic radiating pain.

The history, course and symptoms of ruptured discs are quite characteristic. The most common type of injury is that sustained during excessive exertion while lifting and twisting in a bent-over posture. The patient may sustain a sudden forward jerk while lifting or carrying a heavy weight, such as when a fellow worker drops his end of a heavy plank and the victim is suddenly jerked downward and forward, or when the patient stumbles while carrying a heavy weight. A second common type of injury is a slip and fall such as on ice or down a flight of steps or ladder, the patient landing on his buttocks in a sitting posture. At the time he often describes a "pop", "snap", or a "giving away" feeling in the lower spine, and may feel a sharp stinging or needle-like sensation radiating laterally into the hip or sacro-iliac area. There may be no further symptoms for months or even years, but often the patient will have recurrent attacks of dull backache or lumbago, or catching, sharp pains subsequent to heavy lifting or other exertion. Then at some time, with or without exertion but often during a period of backache, and either suddenly or gradually, the ache will spread down the course of the sciatic nerve and terminate in the calf, ankle or foot. This type of pain is different and distinct from that of backache, being more sharp, shooting and intermittent, and being more closely related to posture, exertion, straining and to extension of the leg on the thigh. The patient can outline the course of the sciatic nerve by the distribution of the ache, pain and cramping, and the clinical picture by this time has changed from one of predominately back and hip distress to that of "sciatica." He will complain of numbness, tingling or "deadness," most noticeable on either the lateral edge or on the dorsomedial aspect of the foot and great toe, depending upon the nerve root which is involved. In 80 percent of cases the attacks of sciatic pain are intermittent, being precipitated by strain in lifting or other exertion, and often subsiding after a few days or weeks of rest. During the attack, even though the pain is mild, the patient dreads coughing or sneezing for fear of increasing the pain. Straining at stool, laughing or at times even taking a deep breath may increase the pain. Finally there comes a time when the pain is severe, continuous and unrelieved by rest or posture. By this time the patient welcomes even surgical treatment if it offers a reasonable prospect of relief.

The present accepted cause and mechanism of this syndrome is as follows: First, an original excessive strain or other injury while the spine is flexed causes a rupture in the annulus fibrosus; continued weight forces the soft nucleus pulposus and annulus backward, thus stretching the posterior spinal ligament. Nerve filaments in this ligament are irritated, spreading referred pain diffusely in the distribution of the spinal nerves which supply the large back muscles, thus resulting in muscle spasm, postural defect and backache. With farther protrusion, usually laterally through the thinner portion of the spinal ligament, a nerve root is compressed. The pain then becomes sciatic in distribution. Thereafter the variation of intensity and severity of pain depends upon: First, the relation of the protruded disc to the nerve root, and, second, the relation of the disc to the intervertebral space, i. e., the mobility of the disc in protruding from or receding to the intervertebral space.

In the 43 cases in this series, particular attention has been given to the relationship of the nerve root to the protruding mass. A study of the operative findings has shown that there are three distinct types of relationships between the disc and the root. First the root may be pushed laterally and upward against the next higher pedicle. The root is thus fixed, becoming swollen and markedly indurated. Second, the root may be displaced posteriorly, arched over the disc and markedly flattened to ribbon thinness. In this type the root is not easily identified from the surface of the disc capsule (stretched posterior spinal ligament), and can be separated from the surface of the ligament and disc only with difficulty. In these two types the root is usually tightly fixed; we have occasionally seen such dense adhesions of scar tissue between the disc and the dural root sheath as to necessitate sharp dissection. In the third type the root is displaced medially, is loose and not fixed against any solid structure. In this type, pain has been less severe and the signs of nerve root compression less obvious.

In regard to the relation of the disc to the intervertebral space, at exploration we have seen the disc increase its protrusion with extension of the spine and decrease with anteflexion during manipulation of the operating table. In three cases very little protrusion was encountered, but the nerve root was firmly fixed to the posterior spinal ligament at the level of the intervertebral space, obviously the site of a disc which had protruded and subsequently receded. In two cases there was only slight bulging, the root was abnormal and the subjacent substance was brown, soft and semiliquid as was described by Dandy (10). In these cases opening the ligament and removing the fluid and particles of disc relieved the symptoms, leading to the conclusion that the disc substance had changed its degree of protrusion from time to time. Variation in clinical symptoms is further explained by

these changing relationships. The apparent spontaneous cures in the past were undoubtedly on this basis, together with the possibility, as recently postulated by Dandy (11), that discs which break through the posterior spinal ligament may eventually be absorbed. I have encountered a complete rupture through this ligament only twice, once at the third lumbar level with symptoms of partial bilateral paraplegia of only 3 weeks' duration, and again at the fifth level with symptoms of extreme severity but of only 10 days' duration. In the second case, it is conceivable that in time the symptoms may have subsided permanently without surgery, but the duration of acute pain would have been long, and with quite likely some residual disability. Following early operation, the patient returned to duty within 3 weeks.

The objective findings seen in cases of lumbar disc protrusions are flattening of the lumbar curve, muscle spasm, tenderness to percussion at the fourth and fifth lumbar spinous processes, limitation of forward bending and of straight leg raising, and positive Lasègue's sign.³ The neurological signs include slight atrophy or fibrillary twitchings in the tibialis anticus or calf muscles; numbness to pin prick on the lateral edge or dorsomedial aspect of the foot and great toe, depending upon which root is involved and upon the distribution of this root which is subject to individual variation. Due to this varied distribution and to the degree of compression of the root, the Achilles reflex may be normal, diminished or completely absent. We have several times observed a normal ankle reflex gradually diminish and eventually become lost (case 7). When this occurs there can be no doubt that an organic lesion of the root or nerve exists, in counter-distinction to other conditions giving referred neuralgic pain.

The most helpful and important advance in this subject in our opinion, is the recognition and diagnosis of the low lumbar disc syndrome on the basis of the symptoms and findings alone and without the use of intraspinal contrast media (12) (10). The first discs were found by lipiodol x-ray studies; later they were demonstrated by air contrast x-rays, and more recently by thorotrast (13). There is danger in leaving thorotrast in the subarachnoid space of the spinal canal. However, this medium is fairly easily removed by forced spinal fluid drainage. We have improved the method of drainage by placing the patient on his side with the bed in a Fowler position. An 18-gage needle is placed at the fifth lumbar space, and a 19-gage needle at the first or second lumbar space. Twenty or 30 cc. of mixed spinal fluid and thorotrast are drained, whereupon the patient begins complaining of headache, due to decreased intra-

³ With the patient supine, the thigh is flexed to 45°. The leg is extended until pain is felt, then is slightly relaxed just enough to relieve pain. In this position, the foot is passively dorsiflexed. Precipitation of pain in the sciatic distribution indicates nerve or root irritation rather than hamstring muscle pain.

cranial pressure. A flask of normal saline solution is then connected with the upper needle, and the flask placed at or slightly above the level of the head. By adjusting the level of the flask, headache can be completely controlled, and at the same time a through-and-through irrigation of the lumbar spinal canal is accomplished. By this method the patient is comfortable during the drainage, the thorotrast is more completely removed, and the drainage can be accomplished in about 15 minutes. We have used thorotrast for myelography in 18 cases (not all in this series), and we feel that we have been able to demonstrate the lesion more often than by using either air or lipiodol. The disadvantages, however, are that the complete study from the time of the injection to the completion of drainage requires about 2½ to 3 hours, requires three spinal punctures, and causes a febrile reaction with generalized aching for about 48 hours. In reserving the use of any type of myelography for those patients who were most certain to have a disc, we have found such a high percent of discs that its use did not justify the information gained. Contrast media myelography has therefore been discontinued in favor of a limited exploration on the clinical findings alone. In the 26 Navy cases no lipiodol was used, thorotrast was used in the first 5 cases, and no intraspinal medium of any kind was used in the last 21 cases.

The second most important advance has been the use of a very limited surgical approach for the removal of discs, as advocated by Love (?). Formerly a complete laminectomy was done, often requiring between 2 and 3 hours, with the loss of considerable blood. In this series all patients were operated by the following procedure: Preoperative sedative and morphine are given and a spinal or local anesthetic is used. A midline incision is made and a subperiosteal elevation of the muscle and tendon attachments is made from one side only of the spinous processes and laminae of lumbar 4 and 5 and sacral 1 vertebrae. The ligamentum flavum is then incised near the midline and is resected from the adjacent edges of L 5 and S 1 laminae. By using a Kesson rongeur, a few millimeters of the edges of these laminae are resected to make a "trephine" or "decompression opening" sufficient to permit the insertion of the tip of the finger or a narrow retractor forward to the anterior canal wall. Occasionally a wide interlaminar space will obviate the necessity of removing any bone. The protruded disc can then be felt or seen. The nerve root is identified and safely retracted laterally or medially together with the dura proper. After the security of the nerve is insured, the posterior spinal ligament over the disc is incised, whereupon the disc substance will begin to eviscerate itself. All of this substance is lifted from within the "capsule" (ligament) and more

may be curetted from within the intervertebral space. The dural sheath of the root is then injected with a few cubic centimeters of normal saline solution in an attempt to mobilize the nerve root within its dural sheath. Any venous epidural bleeding can be controlled by muscle implants, but large veins along the root should first be identified, separated from the sheath and coagulated. In closing, no sutures are used in the muscle. Silk or chromic gut is used to close the deep fascia, and the skin is closed with silk.

In the last six cases an improvement has been made in the technic of exposing the laminae. Instead of incising the interspinous ligament and deep fascia in the midline, the deep fascia is incised about 3 centimeters lateral to and parallel with the tips of the spinous processes. The muscle is separated from the under surface of the fascia, and the fascia is reflected medially over the spinous processes. Subperiosteal resection then begins about 2 centimeters deep to the tips of the processes on one side only, and is carried downward and laterally in the usual manner. With this modification very little lateral traction is needed for adequate exposure, and the postoperative freedom from back pain and stiffness has been remarkable.

On returning to bed the patient may lie in any position; he is turned with assistance for 2 or 3 days, and boards should stiffen the mattress. Morphine may be needed for a day or two, but aspirin and codeine given regularly do as much in relieving general ache and discomfort. The patient is allowed to sit up on the sixth day and walk on the seventh or eighth day. Most patients can return to full duty within 30 days. In 43 consecutive cases no spinal fusion has been done. The fact must be kept in mind, however, that nerve compression by a protruded disc is in fact a neurosurgical complication of an orthopedic condition, that removing the disc cannot be expected to strengthen the spine. Should the question arise as to the need of fusion, this decision might better be deferred until after the patient is relieved of the neuritic pain, for removal of the disc requires bed confinement for from 7 to 10 days, whereas fusion necessitates bed rest for from 2 to 3 months.

In this series, all patients have been relieved of sciatic pain. The average number of sick days after operation was 30 days. For 1 year following the first operation on naval personnel, only 2 patients had been readmitted to the same hospital, one for catarrhal fever, and the other for neurosis.

Considerable care should be exercised in evaluating the patient's mental reaction and personality before surgery (see case 7). Neurotic individuals would best be treated conservatively. The existed-prior-to-enlistment cases should be given a medical survey for discharge from the service, unless there had been a period of complete

remission of at least 6 months between enlistment and aggravation, and then only if the surgeon believes the patient is sincere in his desire to continue in the service. Before operation the patient should be convinced that he has a single definite cause for his pain, that he does not belong in the large group of "backache cases." Furthermore he should be impressed that he is not to undergo a serious major "spinal operation." In fact, he would be better transferred to a more acute surgical ward where the usual expectation is that most patients will return to duty after a reasonably short postoperative period.

CONCLUSIONS

The experience gained in the surgical treatment of 26 cases of protruded intervertebral discs in the naval service leads to the belief that the service would benefit by the early recognition and diagnosis of cases of protruded discs as the cause of low back pain with sciatica. Experience has shown that the lesion can and should be diagnosed by the clinical findings without the use of contrast media, and that the condition is relieved when the disc is removed by a limited, unilateral, partial hemilaminectomy. A new modification of the surgical technic is described which facilitates the operation and markedly decreases the postoperative back distress.

CASE REPORTS

Case 1.—V. A., captain, USN, age 58 years was admitted October 25, 1941, complaining of severe left sciatic pain. In 1917 while on duty on a destroyer, he slipped and fell down a wet ladder, a distance of about 10 feet. As he fell, he struck most of the steps in a sitting position, and finally landed on the deck in this position. Thereafter he continued duty but suffered with low backache for several years. For the succeeding 20 years this patient had intermittent attacks of low back pain, part of which were associated with sciatic pain. On three occasions he was incapacitated from duty for from 1 to 6 weeks. Most recurrences followed excessive strain, as in lifting, bending, and playing golf. Two months prior to admission the patient began having sciatic pain, and following an afternoon of golf the pain became continuous, severe and disabling. His pain was typically precipitated by coughing, sneezing and straining. The teeth and other possible foci of infection were investigated; several teeth were extracted. Other treatment consisted of bed rest on a hard mattress, strapping, plaster-cast jacket, and physiotherapy. After 2 months of treatment without relief, the patient was partially exhausted. He was extremely discouraged at the prospects of his being invalided from the service since he was not long due for a physical examination for promotion.

On examination the spine was tender to percussion at fourth and fifth lumbar levels and the normal lumbar curve was totally absent. Forward bending and straight leg raising were limited to 20°. Lasègue's sign was strongly positive. The tibialis anticus muscle showed slight atrophy and loss of tone, but the Achilles reflex and the other neurological findings were normal. No hypesthesia could be demonstrated.

The diagnosis of lower lumbar herniated disc was made on the basis of the history and the few clinical findings. On November 4, 1941, a partial left hemilaminectomy was done under local novocaine and pentothal intravenous anesthesia. On arousing from his anesthesia, the patient immediately assured us that his pain had disappeared, and that he was certain the cause of his pain had been removed. Paresthesias were present for a few days and subsided; he was ambulatory on the twelfth day, spent most of his convalescence at home and on leave, and returned to duty on the sixtieth postoperative day. Within a month he passed a routine physical examination for promotion and since has remained entirely free of back and sciatic pain.

Case 2.—E. J. D., storekeeper, first class, USN, age 32 years, was admitted on August 7, 1941, complaining of pain in his lower spine, left hip, and lower extremity radiating throughout the sciatic distribution and extending into his heel. In addition he complained of numbness and tingling in the heel and of weakness of his leg. He had both continuous dull aching and superimposed sharp shooting pain on exertion.

Nine months previously the patient had had a sudden attack of lower back pain while lifting a heavy object. Within a week the pain extended down the posterior aspect of his hip, thigh, and leg, finally terminating in his heel. During a previous hospitalization 4 months before, an Ober's fasciotomy operation had been done with only partial and temporary relief.

On examination the patient walked with a limp, favoring the left lower extremity. There was a loss of lumbar curve, and percussion at the fifth lumbar spinous process was painful. Forward bending and straight leg raising were both limited, and Lasègue's sign was strongly positive. Slight analgesia was present in the fifth lumbar and first sacral nerve root distributions and the tibialis anticus muscle was slightly atonic. Achilles reflexes were present and equal.

On exploration, August 14, 1941, the first sacral nerve root was swollen and indurated. Anterior to this root and presenting between the root and the dura was a firm, fixed nodule of protruded disc measuring 2 by 1.5 by 1 centimeter. After removal of the mass, the root lay free in the epidural space. Following operation the patient was immediately relieved of pain; he was ambulatory on the tenth day and was granted leave of absence on the sixteenth day. He returned to duty symptom-free on the forty-sixth day.

Case 3.—G. H., sergeant, USMC, age 43 years, was admitted on March 26, 1941, complaining of pain in his left hip and sacro-iliac region, which spread down over the buttock and into the thigh, calf, and ankle, where the "pain changes to a frozen feeling." For the past 10 days he had a continuous dull ache with superimposed sharp, shooting pains aggravated by coughing, sneezing, and straining. There was difficulty in bending forward more than about 20°. The pain had been worse at night. He noticed no numbness except just below a fasciotomy scar.

The past history revealed the following: In 1931 while lifting an ammunition case he had twisted backward and to the left, immediately sensing a pain in the lumbosacral area which became very severe within about 4 hours. He spent 3 days in bed and returned to duty in 1 week. In 1936, while coughing, he experienced a sudden sharp pain in his back as if he had been stuck with a needle. For this aggravation he was on the sick list for 8 days. Again in September 1940 an acute attack of back pain recurred, this time with radiation of pain down the sciatic distribution incapacitating the patient for 6 weeks. At that time it was noted that the left Achilles reflex was diminished. On this admission at another hospital the left iliotibial band was severed without improvement in

symptoms. The most recent episode started following an attack of pleurisy, but without particular stress or strain.

The positive objective signs included a healed operative scar on the postero-lateral aspect of the left hip. The left calf was 1.5 centimeter smaller than the right. The left thigh and leg showed definite weakness against resistance; motor power of the ankle was also impaired. Sensation for pin prick was diminished in the fourth and fifth lumbar segments and in the first to third sacral segments. Vibratory and other types of sensation were otherwise normal. The left Achilles reflex was totally absent, while the other reflexes were normal. The spine was limited to 20° for forward bending while lateral bending was decreased in both directions. Percussion at L 5 would reproduce the patient's sciatic pain.

On March 31, 1941, an intraspinal injection of 8 cc. of thorium dioxide colloidal solution (thorotrast) was made, the x-ray films showing an absence of S 1 nerve root filling at the fifth lumbar intervertebral level.

On March 10, 1941, a small, laterally placed protruded disc was removed. The patient was ambulatory on the seventh postoperative day and was discharged to duty at his own request on the nineteenth day completely relieved of pain. Subjectively there was also a feeling of increased strength in the left lower extremity together with an insistence on the part of the patient that his former back distress had disappeared.

Case 4.—R. I. H., chief machinist's mate, USN., age 23 years, was admitted on June 6, 1941 complaining of lower back pain and radiating sciatic pain of 3 months' duration. He stated that while lifting a heavy object from a bent-over position he had experienced a sudden sharp "snapping pain" in his lower spine. Since then he had had recurrent low back pain, and about 4 weeks prior to admission had developed sciatic radiation of pain which was increased in intensity by straining and coughing.

On examination there was tenderness of the fifth lumbar spinous process on percussion, limited back bending and straight leg raising, positive Lasègue's sign, and a mild degree of loss of lumbar curve. Anteroflexion of the neck, particularly with the leg extended while in a sitting position, would reproduce his sciatic pain. The neurological findings included hypesthesia on the posterolateral aspect of the calf, atrophy of the calf, and absence of the left Achilles reflex.

On exploration June 17, 1941, a definite posterior bulge could be felt at the level of the fourth intervertebral disc, but on incision of the posterior spinal ligament there was no further protrusion of the disc substance. The latter was removed by curettage. After operation he was immediately relieved of pain and stated that he could now cough without pain. His back movements gradually improved, and he returned to duty symptom free on the fifty-ninth postoperative day.

Case 5.—E. L., pharmacist's mate, first class, USN., age 32 years, was admitted on July 23, 1941, complaining of pain in his right hip, buttock, posterior thigh, calf and ankle, and of pain extending into his third, fourth and fifth toes. He also complained of numbness and tingling in the outer half of the foot. He stated that 7 months previously, while moving and lifting furniture, he twisted toward the right and felt a sudden, sharp, snapping pain in his lower back. Within a few days the back pain became worse and began radiating down the posterior hip and lower extremity. He was able to continue with his duties. However his activity was markedly restricted due to pain, which was particularly aggravated by lifting, bending, straining, and coughing. He was forced to spend most of his hours off duty reclining, applying heat to his back and thigh and taking aspirin.

Physical examination showed tenderness to percussion at the fourth and fifth lumbar levels, forward bending limited to 40°, limited straight leg raising and posi-

tive Lasègue's sign. On neurological examination a moderate loss of tone was noted in the right tibialis anticus muscle, the right Achilles reflex was absent, and there was slight hypesthesia on the lateral one-third of the foot. Narrowing of the fifth lumbar intervertebral space was shown by x-ray examination.

On unilateral interlaminar exploration August 7, 1941, the first sacral nerve root was found markedly swollen and indurated, and was firmly fixed to the surface of a small protruded disc. The disc had compressed and fixed the nerve root against the pedicle of the fifth lumbar vertebra. A superficial postoperative wound infection delayed his convalescence, but he was immediately relieved of sciatic pain; his ankle reflex returned. He went on leave for 14 days and returned to duty on the fifty-sixth postoperative day.

Case 6.—A. Z., pharmacist's mate, first class, USN., age 28 years, was admitted on September 8, 1941, complaining of a hot painful sensation in his right posterior hip and thigh, and of cramping and muscular twitching in his right calf. There was no back pain or ache, but sciatic pain was made worse by coughing. No history of back sprain or other injury could be elicited, but from July to December 1941 his duties included much lifting of ammunition cases. After December 1941 the symptoms had come on gradually and had increased in severity and frequency. Treatment prior to admission consisted of presacral (probably paravertebral) novocaine injections, epidural caudal novocaine injections, salicylate medication and intramuscular injections of whole blood.

On examination the lower spine was tender to percussion, and the sciatic nerve in the buttock and thigh was tender. Straight leg raising was limited to 20°, Lasègue's sign was strongly positive and the tibialis anticus muscle showed a definite loss of tone and power. The painful right calf measured 12½ inches as compared with the normal left calf which measured 13¼ inches. The right Achilles reflex was about 50 percent decreased. No sensory change could be determined.

On September 16, 1941, protruded disc was found compressing the nerve root at the fourth lumbar intervertebral level. Pain was relieved, the Achilles reflex returned to normal; he was put on outside master-at-arms detail at his own request on the eleventh postoperative day, was granted 30 days leave, and returned to duty on the sixtieth postoperative day.

The following case illustrates a type of complication to be guarded against.

Case 7.—J. S., apprentice seaman, USN., was admitted on August 9, 1941, complaining of typical sciatic pain of only 1 month's duration. He was a Jewish boy of 25 years from Brooklyn, N. Y.; his total service was less than 2 months. His pain had come on suddenly on awakening the morning of July 5, 1941, without history of injury or recent unusual exertion. For 3 years following 1936 he had worked in an iron foundry, had done much heavy lifting, but denied injury or strain of his back.

On examination the lumbar muscles showed spasm, movements were limited, the right hip was painful on pressure, and Lasègue's sign was only questionably positive. The Achilles and other reflexes were normal. The patient was characteristically emotional, spending most of his time in bed moaning, groaning, requesting medication and in general complaining to an unusual degree. X-ray, laboratory and all other physical and neurological findings were normal. The diagnosis was uncertain, and the question of malingering and of an undisclosed "existed-prior-to-enlistment" history arose. For a month the patient was given physiotherapy; Buck's extension and traction apparatus was applied, various medication was given and novocaine injections were done, all without relief. At the end of this time reexamination revealed a loss of the right Achilles reflex, partial atrophy of the right gluteus maximus and tibialis anticus muscles, and hypesthesia for pain, heat and cold in the distribution of

lumbar 5 and sacral 1 nerve roots. These positive findings were definitely on an organic basis, had developed while under observation and treatment in the interval since his original examination, and could not be ignored. After consultation with the chief of surgery, particularly regarding the short period of service, the "existed-prior-to-enlistment" status and the patient's emotional personality, an exploration was done on October 2, 1941. A typical herniated disc was found at the 5th lumbar interspace. The nerve root was stretched over the disc and was moderately indurated. Following surgery, the patient was entirely symptom free; he was ambulatory on the seventh day, he soon did ward and outside detail and was apparently cured. No attempt was made to hasten the patient back into activity. However, when he got word that he was soon to return to duty, and within less than 24 hours, the patient developed a typical neurotic episode; he complained of nervousness, insomnia, tremors, gastric distress, and weakness. He broke down and cried, and insisted that he was not cut out for military life, that it did not "agree" with him, and that the military life was no life for him. He was subsequently transferred to the neuropsychiatric service, where his symptoms immediately subsided upon learning that he was to be surveyed for discharge from the service for medical disability (neurosis). In retrospect, considering the medical, compensation, legal, and humanitarian factors, the question still arises as to whether it would have been to more advantage had the patient been discharged from the service without operation. This case illustrates the necessity for considering many factors other than the surgical diagnosis and treatment in cases of protruded intervertebral disc.

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INTERVERTEBRAL DISC INJURY DURING SPINAL PUNCTURE ¹

By JOHN P. STUMP, Lieutenant Commander, Medical Corps, United States Naval Reserve, and SYDNEY A. NARINS, M.D.

In view of the fact that spinal puncture is in such common use both as a diagnostic and therapeutic measure, any possible complication of the procedure warrants attention. Cases of injuries to the intervertebral disc from the penetration of the needle during routine spinal puncture have been reported by several writers, and the literature on the subject has been well reviewed by Gellman.² The attention of the writers was focused upon this complication of spinal puncture by the case that is here presented.

CASE REPORT ³

X, a 12-year-old girl, was admitted to the pediatric service of Gouverneur Hospital on January 20, 1936, acutely ill. The diagnosis of meningitis was made, and the child was treated by lumbar punctures and the intrathecal administration of antimeningococcus serum. Seven spinal punctures were performed, one each day for 7 consecutive days. The recovery was uneventful, and at the end of 26 days, on February 15, 1936, the patient was discharged from the hospital.

About 5 months later, the patient returned to the out-patient department with the complaint of pain and stiffness in the lumbar region. The symptoms had been of sudden onset. A physical examination revealed a definite involuntary spasm of the lumbar muscles and marked limitation of motion in the lower back. Roentgenographic examination of the lumbar spine showed such slight changes that they were considered to be of no importance. A later study of these films, however, revealed in the lateral view a slight narrowing of the intervertebral space between the third and fourth lumbar vertebrae.

A diagnosis of myositis was made, and the patient was treated by baking and massage. The prompt relief from symptoms that was obtained within three days seemed to confirm the diagnosis.

During the following months the patient experienced several more attacks of pain and stiffness in the low back, and on February 5, 1937, she was again admitted to the hospital. It was at this time that the patient came under our care. A physical examination revealed marked spasm of the muscles of the back.

¹ Received for publication September 28, 1942.

² Gellman, M.: Injury to intervertebral discs during spinal puncture. *J. Bone & Joint Surg.* 22: 980-985, Oct. 1940.

³ From the Fracture and Orthopedic Service of Gouverneur Hospital, Department of Hospitals, City of New York, N. Y.

Lateral bending to the right and rotation to the left were limited, and flexion was essentially absent. The normal anteroposterior curve was practically absent so that, except for a slight kyphosis in the lower lumbar region, the spine appeared to be unusually straight from the fourth thoracic vertebra to the sacrum. Laterally there was a mild deviation to the left in the dorsal region and to the right in the lumbar region. Pressure in the midline elicited tenderness over the third and fourth lumbar vertebrae.

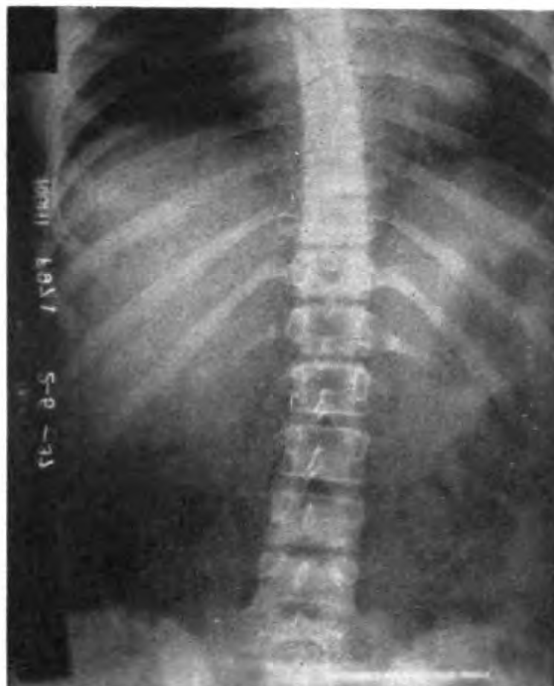
Roentgenograms taken on the day of admission showed the lateral deviation of the spine; a definite narrowing of the space between the third and fourth lumbar vertebrae; and destructive changes in the bodies of these vertebrae that were indicative of an inflammatory process (fig. 1). In another view the loss of the normal anteroposterior curve was evident.

The child was treated at first by rest in bed and hot baths to relax the lumbar musculature. Later she was placed on a hyperextension frame. A roentgenogram taken on April 1 showed that the lumbar spine had assumed its normal curve, but that there was still a narrowing of the intervertebral space between the third and fourth lumbar vertebrae as well as destructive changes in the vertebral bodies. In addition there was an associated widening of the joint spaces above and below these vertebrae (fig. 2).

On April 22, a plaster walking cast extending on the right side from the axillary region to the knee was applied to hold the back in hyperextension. This cast was worn for a period of four months. Roentgenograms taken upon its removal, on August 19, still showed a narrowing of the joint space between the third and fourth lumbar vertebrae, but the increased opacity in the vertebral bodies was no longer demonstrated (fig. 3).

The plaster spica was replaced by a Taylor brace to which was added a cage extension to the right thigh in order to maintain the lumbar region at rest. The patient was discharged from the hospital on September 25, with instructions to report to the out-patient department. The child continued to wear the brace during the day for a period of 6 months. During the following 6 months it was gradually discarded, and massage and exercises were used to develop the muscles of the back.

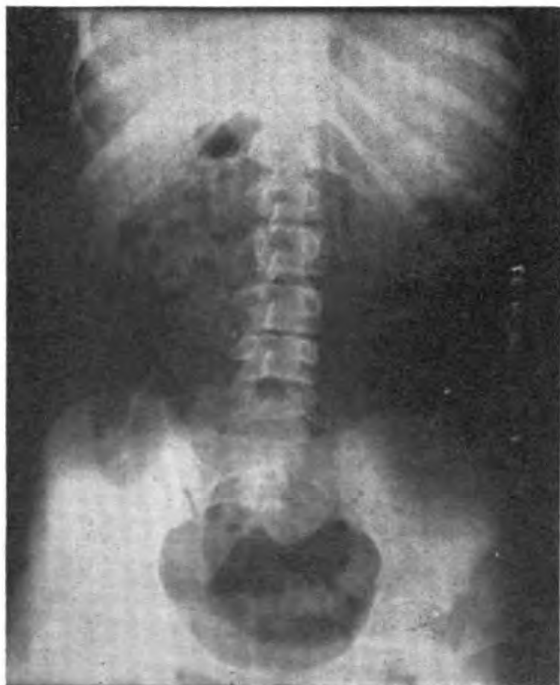
The patient was last examined on May 3, 1940, and at that time there were no subjective symptoms. Motions of the spine were in no way restricted, and



1. X-RAY TAKEN ONE YEAR AFTER SPINAL PUNCTURES, SHOWING NARROWING OF THE SPACE BETWEEN THE THIRD AND FOURTH LUMBAR VERTEBRAE AND DESTRUCTIVE CHANGES IN THE BODIES OF THESE VERTEBRAE. THIS SHOWS THE LATERAL DEVIATION OF THE SPINE.



2. X-RAY TAKEN 2 MONTHS LATER SHOWS THE RETURN OF THE LUMBAR CURVE TO NORMAL; NARROWING OF THE INTERVERTEBRAL SPACE BETWEEN THE THIRD AND FOURTH LUMBAR VERTEBRAE; AND ASSOCIATED WIDENING OF THE SPACES IMMEDIATELY ABOVE AND BELOW.



3. X-RAY TAKEN 4 MONTHS LATER. THE ABSENCE OF CHANGES IN THE BODIES OF THE THIRD AND FOURTH LUMBAR VERTEBRAE IS TO BE ESPECIALLY NOTED. THE LATERAL DEVIATION OF THE SPINE HAS DECREASED.

the patient engaged in all the activities of other girls of her age. Physical examination revealed normal and painless motion of the back and extremities. The muscular development was good and there was no tenderness or spasm. No neurological changes were demonstrable. The anteroposterior curve of the back was normal, but there was a slight lateral deviation. It is questionable whether this lateral deviation was due to the changes in the disc between the third and fourth lumbar vertebrae or to a hereditary tendency, in view of the fact that one of the patient's sisters was being treated for an "idiopathic" scoliosis. Roentgenograms taken on May 3, showed that the narrowing of the joint space persisted, but that the vertebral bodies were normal in appearance except for a slight condensation at their borders (fig. 4).

COMMENT

In this case the clinical manifestations of low-back pain, rigidity of the low dorsal and lumbar spine, muscle spasm, and tenderness appeared about 5 months after a series of spinal punctures for the treatment of meningitis. In roentgenographic studies made at the time of the appearance of the clinical syndrome, only a slight narrowing of the intervertebral space between the third and fourth lumbar vertebrae was demonstrated. Subsequent roentgenographic examination

showed a further thinning of the disc, with increased opacity of the lower portion of the third lumbar body and of the upper portion of the fourth lumbar body. This opacity was considered to be indicative of an inflammatory process. In addition there was a widening of the intervertebral spaces between the second and third and between the fourth and fifth lumbar vertebrae. In later roentgenograms taken at intervals over the period from August 19, 1937, to May 3, 1940, the opacity in the vertebral bodies was no longer present, but the other pathological changes persisted.

This case of an injury to the intervertebral disc would seem to fall into the category of those cases in which an inflammatory process develops following the penetration and perhaps the direct inoculation of the disc by the spinal tap needle. The process apparently caused a partial destruction of the intervertebral disc. If infection was present, it must have been of a low-

grade nature, since the child never ran a temperature and she never had an increased blood count or an elevated sedimentation rate. Throughout the course of the illness there was no clinical evidence that the nucleus pulposus had herniated posteriorly. Roentgenograms taken four years after the attack of meningitis failed to show the development of Schmorl's nodules.



4. X-RAY TAKEN 4 YEARS AND 4 MONTHS FOLLOWING LUMBAR PUNCTURES, SHOWS THE NARROWED DISC BETWEEN THE THIRD AND FOURTH LUMBAR VERTEBRAE; A RELATIVE WIDENING OF THE ADJACENT INTERVERTEBRAL SPACES; AND A SLIGHT CONDENSATION OF THE LOWER BORDER OF THE THIRD LUMBAR AND OF THE UPPER BORDER OF THE FOURTH LUMBAR VERTEBRAE, AND THE DECREASE IN LATERAL DEVIATION.

MUSCLE HERNIA OF THE LEG¹

A STUDY OF 21 CASES AND 38 HERNIAS

By PAUL E. McMASTER, Lieutenant Commander, Medical Corps, United States Naval Reserve

Hernia of muscle has received but slight mention in the literature and as this condition is often misdiagnosed and apparently quite common, a study of 38 such hernias in 21 individuals is reported.

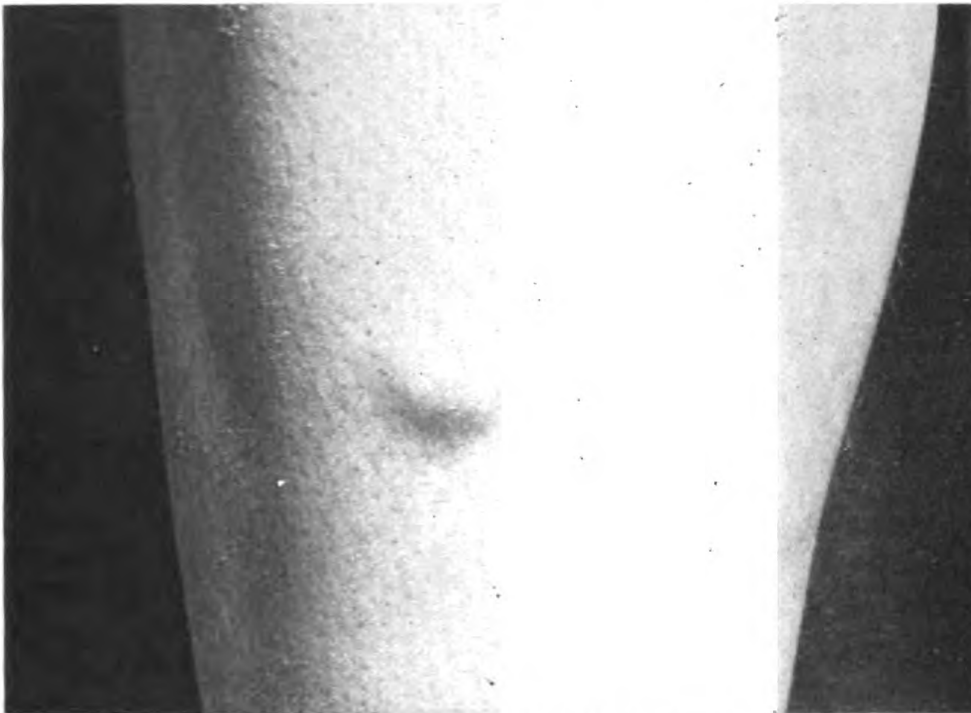
McWilliams (7) in 1901, reported a hernia of the adductor longus muscle, which was repaired surgically, and this is the earliest reference to muscle hernia found. Keen's Surgery (5) states, "True muscular herniae are rare and consist in the protrusion of muscle tissue through an opening in its sheath. They are the result of injury or disease." Ihde (4) reported 12 cases of muscle hernias of the anterior aspect of the leg and distinguished 2 types, traumatic and constitutional or distention type. Four of his cases were traumatic and 8 constitutional. Surgical repair was done on 3 cases.

Conwell and Alldredge (1) state that a herniation of a muscle has seldom been described but probably is very common. They described a muscle hernia of the thigh resulting from a direct blow by sledge hammer. Two cases of hernias resulting from direct trauma of tibialis anticus muscle have been described, one each by Haldeman and Soto-Hall (2) and Hartzell (3). Each was repaired with fascia lata with satisfactory results. Schmier (8) reported a painful hernia of each leg in a youth of 21, which developed after playing basketball. Several injections with sodium morrhuate gave improvement but some pain and swelling remained. Sherry (9) reported a case with bilateral herniation of peroneus brevis muscle and stated that herniation of a muscle belly through a defect in the overlying fascia is uncommon.

The 21 cases, all male, with a total of 38 separate muscle hernias, were seen at the Marine Corps Base at San Diego, Calif. All except one were on the anterior and lateral aspect of the leg (fig. 1). The one exception occurred on the posteromedial aspect of the calf. Nine of the cases had a single hernia, 12 had multiple hernias, of which 5 were bilateral. One patient had 3 hernias of one leg and 2 of the other, while another had 4 distinct hernias of one leg. Only two patients could recall a direct trauma which preceded a hernia. One was a 20-year old male who had been kicked on the upper outer leg in football 6 months previously. Swelling and ecchymosis developed. A tender mass persisted, which was painful with excessive marching. The examination revealed a bulging, soft, compressible, somewhat tender muscle mass on the lateral aspect of the upper leg, and a sharp under-

¹ Received for publication August 31, 1942.

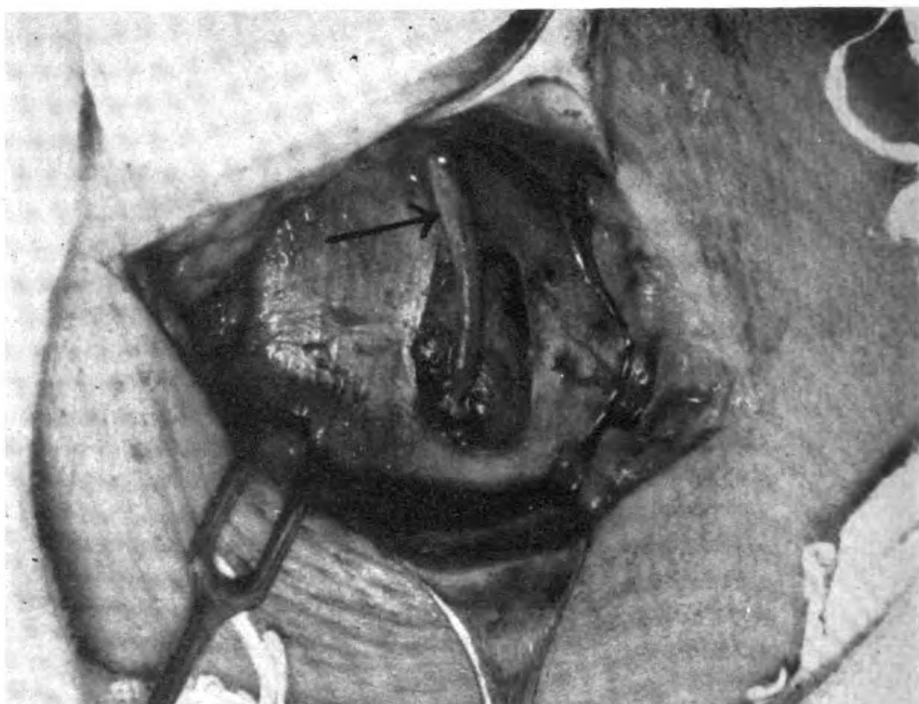
lying fascial defect measuring approximately 3 by 1½ centimeters. Radiographs revealed periosteal roughness of the fibula underlying the defect, substantiating the previous direct injury. Surgery was refused. The other case had a large muscle hernia of the tibialis anticus muscle following a laceration made by a knife. The defect measured 4 by 3 centimeters. Walking caused much pain and cramping and prevented him from drilling. Surgery was refused.



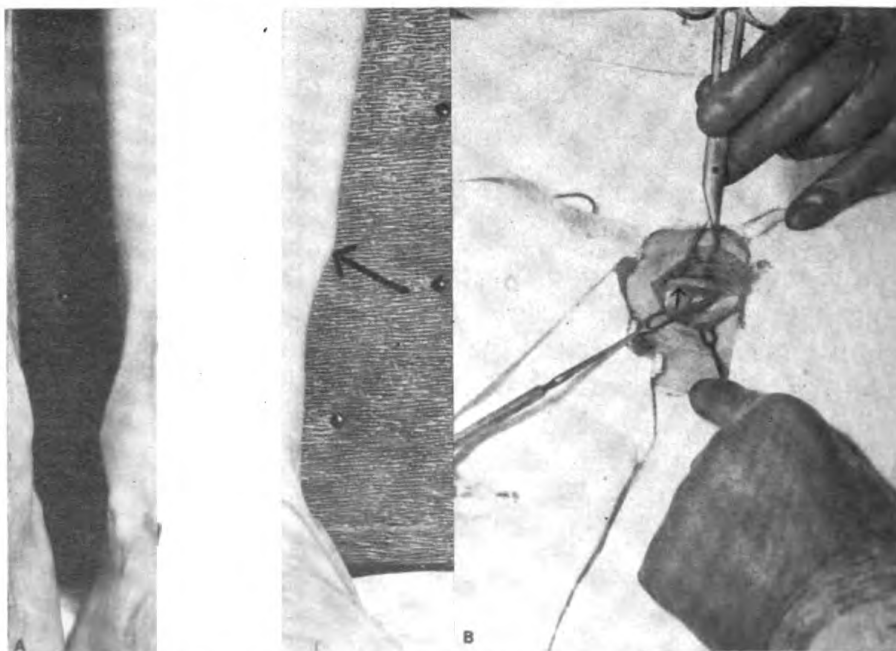
1. TYPICAL APPEARANCE OF MUSCLE HERNIA ON ANTERIOR SURFACE OF LEG INVOLVING THE TIBIALIS ANTICUS MUSCLE. PICTURE TAKEN WITH PATIENT STANDING.

All the other cases were of an indirect type without any recalled previous direct trauma. The hernias were of the tibialis anticus and peroneal muscles except one which involved the flexor profundus digitorum. The latter occurred where a fair-sized vessel penetrated the fascia to become superficial (fig. 2). Five of the hernias occurred on the lateral surface of the lower third of the leg where the superficial peroneal nerve pierces the fascia to become subcutaneous (fig. 3).

Symptoms were variable. Seven of the patients, of whom four were doctors, had no symptoms and the hernias were discovered incidentally. One of the doctors had two hernias which had been present and stationary in size without symptoms for over 30 years. The most common complaints were aching and cramping of leg muscles and pain along the shin bone. Others had a burning feeling of the leg and foot and a slipping or popping sensation when the leg muscles were alternately relaxed and contracted.



2. LARGE FASCIAL DEFECT WITH FLEXOR PROFUNDUS DIGITORUM MUSCLE SEEN THROUGH THE OPENING. A BLOOD VESSEL (ARROW) IS SEEN EMERGING THROUGH THE DEFECT FROM THE MUSCLE TO BECOME SUBCUTANEOUS. THE DEFECT MEASURED TWO BY THREE CENTIMETERS.



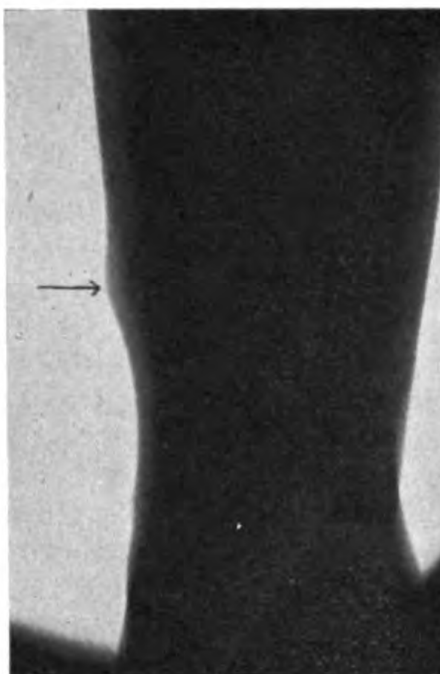
3. (A) MUSCLE HERNIA (ARROW) TAKEN WITH PATIENT STANDING. (B) SURGICAL EXPOSURE SHOWING OVAL SHAPED FASCIAL DEFECT MEASURING ONE AND A HALF BY TWO AND A HALF CENTIMETERS. THE PERONEUS BREVIS MUSCLE IS SEEN THROUGH THE DEFECT, AND EMERGING THROUGH THE DEFECT TO BECOME SUBCUTANEOUS IS THE SUPERFICIAL PERONEAL NERVE (ARROW).

The hernias presented uniform findings, being soft, compressible, round or oval, not discolored masses, which did not pulsate. Digital palpation revealed a well-circumscribed defect of the sheath into which the mass or hernia was reducible. With the leg relaxed in the prone position the mass disappeared in each case, and in some a dimpling of the overlying skin was seen. Contraction of the involved muscles did not usually cause the masses to become more prominent although weight bearing did, and the masses then were as a rule pronounced and firm. Tenderness of the mass and the involved muscle was noted in some. Neither motor weakness nor sensory changes were noted. Radiographic examination, using soft tissue technic and taking a side view of the hernias, revealed in several cases a protrusion of the normally even continuity of the muscle fascia (fig. 4).

Several of the cases had had diagnoses made of varicose veins. The first man of this series was thought to have a localized varicose vein. Needle aspiration, however, was negative and at surgery a muscle hernia was found.

Thirteen hernias in eight patients were repaired surgically. Local anesthesia was used in all except one, for which intravenous pentothal was used. The findings at surgery revealed uniformly an oval or elliptical defect averaging 1 to 2 centimeters in diameter in the muscle sheath, the edges of which were smooth and sharply defined. Normal appearing muscle protruded through each defect without any local evidence of old or recent injury. Chromic catgut was used for repair of each and in some it was necessary to excise protruding muscle to allow adequate closure without excessive tension. In the defects associated with the superficial peroneal nerve of which four were operated, closure was made with care, not to constrict the nerve. Even so one man complained of paresthesia of the dorsum of the foot for a few weeks, but this completely disappeared. In the defect of the flexor profundus digitorum the blood vessel was ligated and sectioned and the defect completely closed.

Strain and weight bearing of the leg was limited after surgery by the use of crutches for 12 to 14 days, and activity restricted for another



4. RADIOGRAPH USING SOFT TISSUE TECHNIC AND WITH PATIENT STANDING. BULGING OF FASCIA (ARROW).

week. Satisfactory results, judged by restoration of normal contour and improvement of symptoms, resulted in 9 of the 13 hernias. The others had recurrences and symptoms of aching, although less than before surgery. Two of these walked on the operated leg against advice and one developed a wound infection with extrusion of chromic sutures. In this case scarring following the infection apparently was the cause for improvement both in symptoms and appearance.

Microscopic study of excised muscle tissue from two cases was made at the United States Naval Hospital at San Diego, and was reported, "skeletal muscle well preserved with a few areas of recent slight hemorrhage into the interstitial tissues."

DISCUSSION

Hernia of a leg muscle through a defect in the sheath apparently is of fairly common occurrence, for 21 cases with 38 hernias were seen by the author among approximately 1,800 admissions to the orthopedic clinic of the Marine Corps Base at San Diego. Other cases of hernia may not have been discovered, as all do not cause symptoms. Only two of the cases were preceded by a recalled direct trauma, either recent or remote, and none at surgery nor by microscopic examination revealed any evidence of local or regional injury or disease. Hence it is the author's opinion that the defect of the sheath occurs as a result of either a rupture of the sheath following strenuous physical activity and rapid muscle development as with athletics and military training, or a gradual enlargement of a normal fascial opening as for passage of either the superficial peroneal nerve or a blood vessel (figs. 2 and 3).

It would appear from this study that a more accurate description of the hernias than traumatic and constitutional, as suggested by Ihde, would be direct and indirect. The latter are much more common and the impression gained from studying 21 patients with this type of hernia is that they are not predicated on a constitutional weakness. All cases studied were healthy, well developed males, active in military service.

Ihde points out that a proper recognition of muscle hernia may be important from a medicolegal angle, as in making a differential diagnosis between it and varicose veins. Hernia should not be confused with muscle rupture in which case muscle fibers are torn and the sheath usually remains intact unless directly severed (6).

Surgery is indicated in those cases associated with the most common symptoms of aching, cramping, and pain of the leg, especially if no other explanation for the symptoms exist, such as muscle strain from weak feet, circulatory disturbances or underlying infection or neoplasm. Repair may be done with either chromic catgut or silk.

and if the defect is large as of the direct type, fascia lata as advised by Ihde may be preferable. Weight bearing should be prevented for 12 to 14 days and then further partially protected for an additional week. Immobilization by casts or other rigid supports appears to be contraindicated, especially if muscle tissue has been excised, because of the possibility of adhesions forming between muscle and sheath at the operative site.

SUMMARY

Twenty-one cases with 38 separate muscle hernias of the leg are reported and discussed. Thirteen hernias in 8 patients were repaired surgically. These hernias are apparently quite common and are apt to be mistaken for varicose veins. They may be of either a direct or indirect type, and the latter, without definite preceding direct trauma, are much the more common. One or more hernias may coexist on the same leg, also they may be bilateral.

The common symptoms of aching, cramping and pain of leg muscles, are not always present and the lesions may be discovered only accidentally. Diagnosis is made by the above symptoms and by physical examination, the latter revealing a protruding mass, averaging 1 to 2 centimeters in diameter, usually on the anterior or lateral aspect of the leg, soft, compressible, sometimes tender and associated with a sharply palpable defect in the underlying fascia. Radiographic examination using soft tissue technic is helpful in diagnosis.

Treatment consists of surgical repair, for those cases having symptoms.

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A NEW ASPECT OF MUSCLE REINNERVATION¹

A PRELIMINARY REPORT²

By H. E. BILLIG, JR., Lieutenant, Medical Corps, United States Naval Reserve,
and A. VAN HARREVELD, M. D., Associate Professor of Physiology

An attempt has been made to increase in paretic muscles the amount of muscle material innervated by the motor nerve fibers which have escaped destruction. It is known that in lower animals more than the normal amount of muscle material can be innervated by a nerve structure. For example Weiss (1) found it possible in *Amblystoma* to innervate an extra front leg with the brachial plexus, thus doubling the amount of muscle material innervated by that structure. The only way in which more muscle fibers can be reached is to make the motor axons divide more extensively than they normally do. It is well known that regeneration of nerve fibers in general is accompanied by branching (2) (3).

The procedure used was to interrupt the intact nerve fibers of the motor nerve innervating a paretic muscle and to depend on the tendency for branching, during the regeneration, to obtain an increase in the number of active muscle fibers.

Experimental as well as clinical attempts along these lines have been made previously (2) (4) (5). Only Dogliotti (5) reported improvement after nerve interruption in a patient. In all the previous work the interruption was performed on mixed nerves. In this investigation the axon interruption has been performed on motor nerves, which contain fewer sensory fibers.

The aforementioned method was first tested experimentally in rabbits. A severe paresis was produced in the quadriceps muscle by pulling the sixth and seventh lumbar spinal nerves out of the spinal cord. A few motor fibers, mostly contributed by the fifth lumbar, remained intact in the femoral nerve. Regeneration of the fibers of the sixth and seventh lumbar was prevented with certainty by pulling out the spinal nerves. The operation was performed bilaterally, producing a symmetrical paresis of the quadriceps muscles. On one side the femoral nerve was crushed with fine forceps, which causes an interruption of the nerve fibers without interruption of the sheath. On the other side the nerve was left untreated. After allowing a period of five to six months for nerve regeneration, the muscle force was compared in both quadriceps muscles by recording the muscle contractions isometrically, stimulating the femoral nerve electrically. In the majority of the experiments a larger muscle

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² From the William G. Kerckhoff Laboratories of the Biological Sciences, California Institute of Technology, Pasadena, California.

force was recorded on the side where the nerve crushing had been performed. The advantage of the treated side was on many occasions several times that of the untreated side. Preparations made of both femoral nerves central to the crushing showed no significant difference in number of fibers left intact.

It is thus possible to obtain with this procedure an increase of the muscle force in a severely paretic mammalian muscle. Since it was impossible to predict the extent to which such a procedure could be beneficial in man, a limited number of poliomyelitic patients with severe residual paresis were treated in the way described. About 2 years ago the first patient was operated on, a boy of 16 years with a 3-year history of poliomyelitis resulting in a foot drop. He had a localized but very severe paresis in the tibialis anterior, extensor digitorum longus and extensor hallucis longus muscles. The deep peroneal motor nerve branches were crushed. This operation, of course, resulted in complete paralysis of those muscles until the time the motor axons again had grown out from the point of interruption and established contact with the muscle fibers. It has been generally believed that motoraxons grow at the rate of about 1 millimeter a day. However, very recently, Gutmann et al. (6) found that this estimate is much too low, and that the growth more nearly approximates 4 millimeters in crushed rabbit nerve. It seemed advantageous to perform the motor axon interruption as close as practicable to the paretic muscles in order to shorten the convalescent time, and also to avoid as many sensory fibers as possible. Immediately following the operation a short leg brace was fitted to prevent foot drop. No physical therapy of any type was used at any time, but the patient was instructed to use the foot as much as he was able in his normal activity. After 2 months return of active motion began, which became stronger as time went on. At present the boy has full functional power in the leg and foot. The muscles have regained their size so that external measurements of leg circumference closely approximate those of the unaffected leg.

Fourteen months ago the second patient, a woman of 33 years, with a 1-year history of poliomyelitis resulting in a very severe paresis of all the muscles of the right leg, was operated on. She was unable to use the leg without the constant support of a long leg caliper brace with knee and ankle locks. Return of muscle power under constant physical therapy had been only slight after the attack of the poliomyelitis, and had ceased entirely for several months prior to the operation. The femoral motor nerve branches were crushed as near the muscle as possible, and the tibial nerve was crushed in the popliteal region. After the operation the patient had a feeling of excessive warmth in the lower leg and foot, becoming pronounced for a time. This feeling of warmth subsided in about 7 weeks. There was also a loss of superficial sensation in the area of the lower leg and foot supplied by the

posterior tibial nerve, which was completely regained in about 3 months. The brace was reapplied after operation and the patient was urged to attempt to use the muscles by continuing the same activity as prior to operation. No other physical therapy was used for 3 months, by which time the muscles had recovered more power than had been present prior to operation. Physical therapy, consisting of active individual muscle exercises, was started at 3 months, and is being continued. The muscles have made considerable further recovery, and the patient is now walking correctly without the aid of a brace.

Two further cases were operated on, 12 months and 11 months ago, using the technic of interruption of both motor and sensory axons in the tibial nerve. Slight progressive slow increase in muscle power over that present previously to operation is being noted. The diminished and delayed muscle power recovery, as compared with our first case operated, led to continuation of the method as in that first case of interrupting the axons closer to the muscles in order to avoid as much as possible the sensory nerve components.

To date 102 more cases, averaging three separate nerve muscle group operations per case, have been added to the operative series. Appreciable progressive increase in muscle power over that present previously to operation is being noted in the great majority of cases in which the time since operation has been sufficient for the regenerating nerve fibers to reach the muscle fibers. The regeneration time of these cases supports the Gutmann et al. contention that the process of functional completion proceeds down the nerve faster than the usually accepted 1 millimeter a day. In these cases care was taken to interrupt the axons close to the muscles by gently crushing each of the motor nerve branches bluntly over a narrow area with a Kelly hemostat without shearing the sheath or otherwise disrupting it. The purely sensory nerve branches were, if possible, left intact.

Attempts are also being made, in a series of cases, to produce the axon interruption by means of manual methods without the use of surgical incision. This has been done by vigorous kneading of the muscles with a smooth blunt instrument, concentrating particularly on the area of entry of the motor axons in the muscle. The smooth round end of a mallet handle has been used for this purpose, using the mallet head as grip. The first patient was a woman of 42 years with a history of poliomyelitis at the age of 5 years and marked residual paresis of the muscles in both legs. No improvement in muscle force had been noted for many years. In this instance, the procedure was carried out unilaterally on the femoral nerve branches and muscles supplied by them. The postoperative course has approximated that of the direct axon interruption, and muscle power in those muscles supplied by the femoral nerve has now, 9 months later,

increased over that present at the time of the treatment. This patient had considerable paresis in other muscle groups of the same leg. Physical therapy has been applied to all muscles yet the only definite improvement has been in the femoral nerve muscle group. Axon interruption by means of manual pressure does not completely interrupt all the motor axons, so that temporary total paralysis does not result.

In about 50 cases the gluteal muscles have been treated by manual pressure over the muscles with concentration in particular over the region of entry of the motor nerves. Early progressive increase in muscle power over that present previously to operation, is being noted in nearly all these cases. In many instances the resultant increase in power has already reached the point of functional usefulness.

The above series of cases include also those of muscular paresis due to other etiological factors than poliomyelitis. Those cases resulting from traumatic injury, such as partial nerve root avulsions, have responded particularly well.

From data supplied by Mr. James G. Woolley, secretary of the Los Angeles County Chapter of the National Foundation for Infantile Paralysis, Inc., a considerable number of cases have been listed illustrating how the principle presented in this paper may explain the various successful cases of improvement from paresis treated by a variety of methods. In the methods resulting in definite improvement, a factor of specific trauma applied in some manner as a part of the treatment can be noted. It is possible that such trauma caused motor axon interruptions, leading to increased muscle reinnervation during regeneration.

We wish to thank Dr. C. A. G. Wiersma for his continued interest and suggestions in this research.

SUMMARY

A hitherto neglected approach to the problem of functional improvement of paretic muscles is being studied. The principle used in this approach is reinnervation of muscle fibers by means of increased nerve fiber branching during regeneration after interruption.

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INTRAMUSCULAR PRESSURE¹

VI. THE PHYSIOLOGY OF THE VENOPRESSOR MECHANISM AND THE IMPORTANCE OF MAINTAINING INTRAMUSCULAR PRESSURE IN THE TREATMENT OF THE PERIPHERAL COLLAPSE OF SHOCK AND SHOCK-LIKE STATES

By LEWIS GUNTHER, Lieutenant Commander, Medical Corps, United States Naval Reserve

The intramuscular pressure of the muscles of the body is a factor of greatest importance in the maintenance of the peripheral circulation. It is a determinant of venous pressure and the volume of venous flow and cardiac filling. Without it, peripheral circulatory failure and collapse ensues.

Based on the observations and experiments of my collaborators² part of which material has been published (1)(2)(3)(4)(5), I propose to elaborate on Henderson's postulate of hypotonia and the venopressor mechanism (6), and to demonstrate a simple, effective means of restoring intramuscular pressure and of maintaining the flow of the peripheral circulation after injury, even on the field of battle.

Henderson calls intramuscular pressure "muscle tonus" and shock "hypotonia." He feels that the tonus of the body muscles supports and maintains the venous circulation and that the loss of muscle tone in shock is one of the most important factors in the failure of the peripheral circulation. Thus muscle tonus is the determinant of venous pressure and of the volume of venous flow.

This relationship between the tonus of muscles, and venous pressure and the volume of venous flow is the *venopressor mechanism*.

All observers are in agreement on one thing in shock and in shock-like states, namely, there is a peripheral collapse, or *forward failure* (7). By this is meant the inability of the blood to return to the heart from the peripheral blood vessels.

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² Dr. H. Engelberg, Dr. Ludwig Strauss, Dr. H. H. Henstell, and Mr. Edward Johns, student at the College of Medical Evangelists.

The striking and outstanding physical signs are the *empty* and *bloodless veins* (6). The venous pressure is low and it is difficult to insert needles into the collapsed veins. All of us who have given intravenous medication in shocklike states can attest to these facts.

The common autopsy findings are the bloodless heart, with a great volume of blood collected in the abdominal viscera and lungs (8), and the muscles practically without blood.

So far, in the picture of forward failure, or peripheral collapse, the heart itself has not failed. This is in contrast to the syndrome of *backward failure* (congestive heart failure) (7), in which the outstanding and striking clinical feature is the *distended and overfilled veins*. The venous pressure is high (6) (23). The veins are entered easily, and the blood spurts into the syringe.

While all investigators are in agreement regarding the existence of peripheral failure in shock, none agree as to the mechanism by which these phenomena occur.

As causes of shock, many writers discuss the injury to the capillary bed through the "H" substance, loss of blood volume, hemoconcentration, electrolyte imbalance, and insufficiency of the adrenal cortical hormone (8). Because of the drop in blood pressure, others talk in terms of "vasomotor failure." However, as Henderson (6), Harrison (7), and others have pointed out, there is no failure of the sympathetic system in shock. On the other hand, the converse is true. The vasomotor system is making marked efforts to compensate for the loss of blood volume by contraction of the arterial bed (6) (24). It supports the level of systolic blood pressure for a long time before the return to the heart becomes so inadequate that ventricular filling fails. This is well attested clinically by

(a) The pallor of the skin due to constriction of the capillary bed.

(b) Failure of the blood pressure to fall for a considerable time after cardiac output has diminished.

Capillary injury, electrolyte imbalance, loss of blood volume, eventual fall in blood pressure and diminished cardiac output are responsible for the clinical picture of shock. But to Henderson these are the results of another factor and not the cause of peripheral collapse and shock. The fundamental mechanism must be sought elsewhere in the dynamics of the circulation.

The concepts of cardiovascular dynamics have changed considerably in recent years. Even as late as 1924, Harvey's concept of the circulation of the blood still predominated (9). The heart pumped the blood out at a high pressure (120 mm. Hg.), and other than the action of the diaphragm and the negative thoracic pressure produced thereby, no other mechanism to produce an additional major force to bring the blood back to the heart was proposed. It just got there. But it is

obvious that blood pumped out at a high level of pressure entering a wide capillary bed of low pressure (12–32 mm. Hg.) and returned via the veins at still lower pressure (10–12 cms. H₂O) could not get back to the ventricle by itself. There is not that much vis a tergo in the arterial side of the circulation. Without the aid of another force the blood could not just flow “up-hill” to the heart.³

The recognition for the need of other agencies to return blood to the heart has recently appeared in texts on physiology. Wright (10) in 1940 listed the following factors upon which the venous return depends:

1. The contractions of the skeletal muscles squeeze the veins contained within them and drive the blood on toward the heart. The valves of the veins prevent regurgitation.
2. The negative pressure in the pleura aspirates blood toward the heart. The descent of the diaphragm, by raising intra-abdominal pressure squeezes blood out of the splanchnic veins.
3. The slight positive pressure in the capillary bed, 12–32 mm. Hg., and the 10–12 cm. H₂O of the veins can propel blood toward the heart.
4. Gravity assists the venous return from the parts above the heart level and hinders it below that level.
5. Changes in blood volume, which either increase or diminish the venous return.
6. Capillary tone: If the capillary bed becomes dilated, the blood volume is pooled and little is left to return to the veins.
7. Venoconstriction via the vasomotor center, increases venous pressure.

None of these forces, individually or collectively, provides an adequate explanation of the failure of the venous return that occurs in shock. Even in the shock state, the patient can still contract his muscles. Active respiration continues. He still has diaphragmatic movements although they may be considerably decreased before death. The capillary bed is contracted and is transforming all of its possible energy to the veins. They too may be results of, rather than causes of, venous failure.

Yet, to quote Henderson (6), “One has but * * * to use his eyes, to see that the veins, and especially the jugular vein, of a patient lying on his back before operation and those of an animal before experiment, are filled with blood; and that after an hour under anesthesia and operation, or after experiment the decreased vitality and weaker circulation are correlated with empty and collapsed veins.” What

³ If an animal is curarized to prevent muscular contraction, and the effect of the diaphragm and negative pressure is abolished by opening the thorax and maintaining respiration artificially, circulation continues and venous pressure remains unchanged. Henderson (6), Fishberg (27). It is such evidence that lends support to the old thesis that the vis a tergo of the arterial circulation was sufficient to support a return of blood to the heart. Henderson interpreted this experiment differently. The experiment does not negate the postulate of the venopressor mechanism. In view of the data to be presented later, it may be interpreted as additional support for the existence of the venopressor mechanism.

is this factor associated with a decreased vitality that is so quickly correlated with collapsed and empty veins?

Riml's (11) experiment is worthy of description for it throws light on this factor. "The thorax of a cat in deep narcosis is opened. The pulmonary artery is clamped, thereby bringing the circulation to a sudden and complete standstill. Immediately a trochar is thrust into the right heart; and the pressure and volume of the outflowing blood are determined. (The result is extraordinary). A half or more, of all the blood in the body gushes out under a *pressure sufficient to support a column of blood 10 or 12 cm. high*. Where does this blood come from; and what is the force that drives it through the veins toward the heart?" The heart is not involved, for its propelling force is abolished by the clamp on the pulmonary artery. Obviously it must come from the reservoirs of blood in the tissues. The pressure that maintains this flow must be produced within the tissues for it disappears a few minutes after death (6). The vasomotor system is not involved. The experiment worked well on a sympathectomized cat, which had no vasomotor nervous system. Henderson feels that "muscle tonus" is the force that produced the venous pressure of from 10 to 12 cm. H₂O and with it the flow of blood through the veins in the Riml experiment. This tonus disappears a few minutes after death.

Of the tissues, the muscles alone possessing contractility must be responsible for the major part of the transfer of energy to the venous column. All tissues have an inherent pressure and muscles particularly have a pressure of considerable magnitude. Intramuscular pressure in the biceps in humans varies from 60 to 90 mm. H₂O. This pressure markedly decreases in shock. Intramuscular pressure is therefore the power that produces this pressure and with it the flow of blood through the veins to the heart.

With the loss of tissue pressure, i. e., intramuscular pressure, the pressure that the muscles can exert upon the blood in their capillaries is lost. Thus the venous return, *a priori*, also fails. This is the concept of the veno-pressor mechanism for the second circulation postulated by Henderson. This concept has received relatively little attention. *It is the intramuscular pressure of the muscles of the body that maintains venous pressure and the return of blood to the heart* (3) (4) (5).

Locally, we have witnessed the milking action of the contraction of the skeletal muscle in the procedure of doing a venipuncture. After placing a tourniquet on the arm, we ask the patient slowly to open and close the fist. Soon the veins become filled and distended with blood. The valves along them stand out like knots in a string. Micro-

scopically, it is likely that the same mechanism continues in the capillaries and venules which surround the muscle fibers.⁴

All tissues of the body including the muscles have an intrinsic pressure which can be measured (13). As the biceps contracts and relaxes, its pressure increases above or decreases to the resting range of 60 to 90 mm. H₂O. Contrariwise, as shown by Henderson et al. (14), which will be verified and amplified in this paper, after anesthesia and surgery there is a loss of intramuscular pressure. This occurs before the onset of shock and the appearance of collapsed and empty veins which are reflected quantitatively as a fall in venous pressure.

Inasmuch as blood pressure is dependent on venous return and ventricular filling, the tonicity of the muscles of the body is a factor of greater importance in the maintenance of the venous circulation than is that of the vasomotor system.

Intramuscular pressure is a measurable property of muscle. "Tonus" is not.

The term "tonus" has several physiologic usages. In this work, we prefer to speak of intramuscular pressure and not of tonus. Tissue tonus, as used by Henderson may disappear a few minutes after death, but intramuscular pressure does not. Certainly there is a change in the muscle after death. With the needle *in situ* in the muscle in human beings and in frogs, we have never been able to record an intramuscular pressure, even after death, below 18 mm. H₂O. This is the level to which intramuscular pressure falls in postoperative depressions and in shock-like states. But if tonus, a quality of the live muscle, disappears with death, its pressure does not. Eighteen mm. H₂O pressure must represent the resilience pressure of the mass of the muscle itself, for as rigor mortis sets in, the resistance of the muscle mass to the injection of fluid increases (15).

It is the pressure of the muscle above 18 mm. of water that is effective in the dynamics of the peripheral circulation. Therefore, we prefer to think of Henderson's hyoptonia in terms of intramuscular pressure, a property of living muscle which can be measured.

In view of the above, our concept of the venopressor mechanism differs from Henderson's in the following manner. The venopressor

⁴ Krogh (12) has shown that a muscle at rest has relatively few open capillaries. Under active contraction, the capillaries are wide open, dilated and gorged with blood. Individual muscle fibers are continually contracting and relaxing. The minute vessels also are continually contracting and relaxing. At one moment a few capillaries are open and the rest are closed. Another group opens and the first group closes. According to Henderson, it is possible but not proven that the capillaries which at any instant are opened are those around the muscle fibers which at that moment are active. If properly timed such a relation might form a microscopic sort of venous pump.

mechanism is the relationship between intramuscular pressure, venous pressure and the volume of flow in the venous system. As long as intramuscular pressure is maintained, venous pressure and cardiac filling remain adequate. When intramuscular pressure fails,⁵ venous pressure, venous flow, and cardiac filling become inadequate.

My interest in the role of intramuscular pressure in shock was aroused at the autopsy table by observations on three patients who had died in shocklike states. All the present theories advanced to explain the circulatory disturbances in shock, which really account for the clinical picture of shock, such as the failure of the adrenal cortical hormone, disturbances in electrolyte balance, formation of the "H" substance, capillary damage and hemoconcentration, could not possibly explain these autopsy findings; namely, that the lungs occupied only a small part of the chest cavity. They were collapsed against the posterior wall of the chest and hugged the spine. *The diaphragm was high in the chest* (at the level of the third anterior rib.) It was flaccid, and greatly decreased the potential volume of the chest cage which even then was not occupied completely by the small volume of the lungs. The lungs were oozing with red blood, but not pneumonic. The general size of the rib cage was decreased. The interspaces appeared to be small for the particular individual.⁶ They were as high in the chest as one sees after bilateral interruption of the phrenics, which is in contrast to the normal expiratory position of the diaphragm at death.

The diaphragm is a strong muscle. It is maintained in its normal functional position by rhythmic impulses from the spinal cord. So too is the size of the rib cage maintained by rhythmic impulses from the respiratory center to the intercostal muscles, these impulses being in the neighborhood of 25 per second (10) (in deep breathing 40 to 100 per second). In the usual postmortem patient the diaphragm is fixed in death not far from the expiratory position. Thus, in these patients seen at autopsy, the diaphragm must have been in a greatly relaxed and flaccid state just antemortem. What had happened? Were the central impulses interfered with? Had the muscles lost their intramuscular pressure? These observations led to a study of intramuscular pressure on humans in a variety of conditions. From these studies, certain inferences can be drawn to explain the phenomena.

⁵ The critical level has not been quantitatively worked out. The length of time intramuscular pressure remains low is an important factor. If a low pressure is brought up to the range of 40 mm. H₂O or more, venous pressure remains within the normal range.

⁶ The gross and microscopic picture of the lungs, a combination of the findings of atelectasis and of heart failure which results in bloody, wet, oozing lungs has been well described by Moon (8).

Strong evidence can now be produced to show that the level of intramuscular pressure correlates closely to the state of vitality as we sum it up with the eye. The loss of intramuscular pressure in the biceps is found with depressed vitality, shocklike states, a fall in venous pressure and clinical phenomena in the lungs allied to the above postmortem observations.

PATHOLOGIC PHYSIOLOGY

In Henderson's postulate of the venopressor mechanism, the following train of events occur which explains the altered electrolyte balance, capillary injury, loss of blood volume, hemoconcentration, etc., as secondary phenomena.

As the effective pressure of the muscles fail and the energy they can impart to the venous circulation disappears, venous flow becomes slow. The effective volume returned to the heart decreases. Venous pressure falls and cardiac output drops. The sluggish venous blood flow becomes depleted of oxygen to the point where asphyxia of the capillary bed occurs. Then blood proteins escape into the tissues. The osmotic pressure of the arterial system is lost, fluids cannot be held in the circulation, electrolyte balances become disturbed by the loss of fluid, hemoconcentration becomes a fact, and the total blood volume and effective ventricular filling decreases.

If this thesis of the venopressor mechanism and the theory of failure of the intramuscular pressure as the keystone of failure of the venous circulation is to come out of the realm of theory, the following facts should become demonstrable:

1. At the height of the loss of vitality in postoperative depression, in infectious diseases, after hemorrhage and in other shocklike states as judged clinically, the intramuscular pressure should be low.
2. At such a time, the venous pressure should also be low.
3. Preceding any shocklike state or depression, the intramuscular pressure should fall before a fall in the venous pressure occurs.
4. During surgical procedures, the intramuscular pressure should fall before the venous pressure.
5. If venous pressure falls, it should remain low until the intramuscular pressure is raised.
6. If an agent could be found to restore intramuscular pressure, the venous pressure should simultaneously also become elevated and improvement in peripheral circulation should be evident. Such an agent should produce clinical improvement in shocklike states.
7. An increased venous pressure per se, should not alter intramuscular pressure.
8. Pressor agents which act specifically on the vasomotor system should not affect intramuscular pressure.
9. The decrease in vital capacity, so commonly seen in postoperative depression should be due to compression atelectasis of the lungs. This in turn should be caused by an elevation of the diaphragm which, by *a priori* reasoning, should also have lost its intramuscular pressure.

10. An agent which restores intramuscular pressure should also restore the elevated diaphragm to its normal level, and the so-called postoperative pneumonia, or atelectasis, should disappear coincidentally with the restoration of the intramuscular pressure.

11. Maintenance of intramuscular pressure at its normal level should then be followed by an improved peripheral circulation, and clinical improvement should follow.

EXPERIMENTAL AND CLINICAL OBSERVATIONS

Intramuscular pressure was first measured with Henderson's (14) instrument modified by Kerr and Scott. Later the instrument as modified by Gunther and Henstell (1) was used when continuous readings were needed.

Six to twelve hours after operation under either spinal or ether anesthesia intramuscular pressure falls to very low levels. This is coincidental with the degree of depressed vitality so frequently seen after major surgery.

In the normal postoperative course, wherein convalescence occurs without complications, the intramuscular pressure gradually rises, to reach normal by the fourth day; clinically the degree of the patient's improvement approximately parallels the increasing level of intramuscular pressure (2).

The patient who does not recover his intramuscular pressure by the fourth day is clinically still sick, and in this group, the various complications were observed. They were peritonitis, postoperative pneumonia, evisceration, etc. (3).

The height of the postoperative depression is accompanied by low levels of intramuscular pressure. The level rises to normal as clinical improvement occurs.

Those patients who did not recover their normal intramuscular pressure by the third day were in trouble. The shocklike state was obvious. Various postoperative surgical complications appeared. The *venous pressure was very low* in the antecubital vein, and all the signs of peripheral failure were noticeable (3).

During a pericardial thoracentesis a significant drop in intramuscular pressure occurred 5 minutes after the pericardium was pierced and before the patient showed clinical signs of impending shock. Twenty minutes later, the intramuscular pressure had dropped to a very low level, and the venous pressure was likewise found at a low level. The patient was in shock (5).

Patients were studied on the operating table before and during the course of anesthesia and surgery. In one-half the cases, intramuscular pressure showed its first drop after 50 minutes of continuous surgery. Then the venous pressure began to drop. Within 6 to 12 hours, as noted previously, the intramuscular pressure

dropped to its lowest level, and the venous pressure at this time was also at its lowest level (5).

Pressor substances such as paredrine, which have a vaso-constricting action as well, temporarily increase venous pressure but do not alter intramuscular pressure. The increase is measured in minutes (15 to 40 minutes) (4) (26).

Contrariwise, patients in shocklike states, when given coramine show an immediate and spectacular increase in intramuscular pressure within 5 minutes, and in all instances the low level of venous pressure simultaneously returns to normal. The effect lasts for several hours. As intramuscular pressure is gradually lost again, venous pressure falls (3).

Coincident with the restoration of intramuscular pressure and venous pressure, clinical improvement takes place. Patients who were pale, in coma or semicomatose, became flushed and either became restless or awoke from their coma. The clinical improvement and venous pressure levels were maintained for one hour or more, apparently varying with and depending on the severity of the shock state (3).

That an increase in venous pressure, per se, is not a determinant of intramuscular pressure is shown by:

(a) Paredrine which will temporarily increase venous pressure does not change intramuscular pressure.

(b) In congestive heart failure, wherein venous pressures are recorded as high as 20 cm. of water, no alterations in intramuscular pressure beyond the normal range were encountered.

(c) Experimentally, by constricting the upper arm with a cuff, venous pressure in the antecubital vein has been raised as high as 60 cm. of water without any significant increase in the intramuscular pressure in the biceps muscle of that arm (13) (17).

SUMMARY

From the above, it is believed that the theoretical considerations on which are based the thesis that intramuscular pressure determines venous pressure and venous flow and the state of the peripheral circulation, are amply fulfilled.

These observations are strong evidence to support the thesis that except for venoconstricting action of the sympathetics, which temporarily increased venous pressure, the general level of venous pressure and venous flow is maintained only as long as the intramuscular pressure is maintained. Intramuscular pressure fails before venous pressure drops (venoconstrictive mechanism temporarily compensates, just as the arterial and capillary constriction supports blood pressure, even with decreasing cardiac output and/or a decreased circulating volume). The compensatory mechanism alone will not sustain venous pressure, for the failure of intramuscular pressure is followed by a

drop in venous pressure and the peripheral circulation fails. Restoration of venous pressure per se, via venoconstriction, has a temporary effect lasting minutes, whereas a restoration of intramuscular pressure, by the use of coramine, causes a clinical improvement which lasts several hours.

In those patients observed in shock who had compression atelectasis with diaphragm levels clinically at the third interspace and to all practical purposes presenting the clinical picture of postoperative pneumonia, the intramuscular and venous pressures were low (3). Within 5 minutes after restoration of intramuscular pressure, coughing occurs, sputum is expectorated, the percussion levels of the diaphragms move downward and within 30 minutes pulmonary ventilation is again present. It can be inferred that intramuscular pressure of the diaphragm was lost when it was registered as low in the biceps, and that intramuscular pressure was restored not only in the biceps but in the diaphragm as well. Thus the flaccid diaphragm, which had moved upward, compressing the lungs and creating the clinical picture of atelectasis, again moved down to its normal position of function, with consequent aeration of the pulmonary parenchyma. (We must not overlook the possibility of the same phenomena taking place in the musculature of the respiratory tree and its blood vessels.) Strong support for this inference is additionally furnished by the observations of postoperative pulmonary subventilation and a decreased intrapleural pressure by Prinzmetal et al. (18), as well as by the commonly observed heightened levels of the diaphragm and decreased vital capacity after operation, shown by the x-ray studies of Muller et al. (19), and by the decreased pulmonary ventilation studies and demonstrations of a diffuse atelectasis after laparotomy by Beecher (20).

AGENTS WHICH AFFECT INTRAMUSCULAR PRESSURE

We tested many drugs for their action on intramuscular pressure. Among these the drugs most commonly used before, during, and after surgical procedures, such as morphine sulfate, atropine sulfate, ephedrine, paredrine, barbiturates, acetylsalicylic acid, carbon dioxide inhalations, oxygen inhalations, and caffeine sodiobenzoate were without effect. Aminophylline, strychnine, and prostigmine did not alter intramuscular pressure. Blood transfusions, saline or glucose intravenously were all without effect. All these substances had no effect on the intramuscular pressure when low. Inhalations of carbon dioxide gas, and overbreathing, as pointed out by Henderson, will temporarily and slightly elevate an intramuscular pressure which is at the normal level.

One substance was found (coramine) which promptly and spectacularly increased the level of intramuscular pressure from a low level

up to the normal (3) (4). Coramine (pyridine betacarboxic acid diethylamide 25 percent solution) given intravenously in 5 to 10 cc. doses, with rare exception in this dosage restored a failed intramuscular pressure, and with it a low venous pressure to normal. Doses up to 30 cc. in 30 minutes intravenously have been used on the normal individual, and to 20 cc. on a patient in shock to produce the therapeutic effect. It has been used in postoperative depression, in postoperative shock, in acute massive hemorrhage with shock, and in the shock accompanying coronary occlusion. Its use following massive hemorrhage and shock is particularly interesting, inasmuch as the venous circulation was restored without the pressor effect that is seen in normals. The pressor effect of coramine was also absent in other shock states.

CLINICAL APPLICATIONS AND DOSAGE

Intramuscular and venous pressures when restored to normal by the use of coramine will persist for several hours before a gradual decline again occurs. Venous filling and rapid clinical improvement follows, likewise of several hours duration. The ability of coramine to increase intramuscular pressure and venous pressure makes it valuable as an adjunct in the treatment of shocklike states. As was shown by Moorhead (21), the greatest need, and similarly the greatest defect in the treatment of the casualties at Pearl Harbor, was the inability adequately to treat shock early in a large number of the seriously wounded. Coramine which has a decided intramuscular pressure effect, is an ideal agent for use in prevention of peripheral circulatory failure, in the early period of shock. Its administration is simple and can be given by any one who can do venipuncture. Hospital corpsmen are well qualified to carry out such emergency procedures.

The therapeutic effect of coramine is sufficiently prolonged and supportive for the period necessary to enable an injured man to be transported to the station where he can receive the benefits of serum, plasma, and other forms of treatment. The beneficial effect can be renewed by repeated administration and continued by suitable intervals of treatment.

Coramine is a safe agent to use in the shocklike state after massive hemorrhage, for in all conditions wherein the intramuscular pressure is very low, there is no appreciable pressor effect and therefore little danger of increasing the hemorrhage. It is practically without toxicity, and there is no danger of overdosage. The drug carries a warning signal when the injection should cease, by the appearance of coughing. If the coughing sign is overlooked, which is easily possible, the second warning signal is mild convulsive movements. These appear long before the lethal dose can be approached (22).

CONCLUSIONS

The intravenous use of coramine in adequate doses from 5 to 10 cc. is a valuable adjunct in the treatment of the immediate period of shock. The clinical evidence of peripheral collapse rapidly regresses for a period of an hour or more. The effect can be repeated by a second intravenous administration. The time interval is important. Peripheral circulatory support is obtained during the immediate period when fatalities occur. Its use should permit survival until such time when serum and other useful therapeutic procedures can be instituted.

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DISTRIBUTION OF INFLUENZAL ANTIBODIES AMONG VACCINATED AND UNVACCINATED NAVAL PERSON- NEL ¹

By the Personnel ² of Naval Laboratory Research Unit No. 1, United States Naval Reserve, University of California, Berkeley, Calif.

In January of 1941 the Surgeon General of the Navy directed that the personnel of this activity be assigned to investigate certain aspects of epidemic influenza. One phase of the investigation was the evaluation of vaccines developed for use as immunizing agents. To accomplish this purpose a vaccination test program was conducted during the summer of 1941 among the personnel of several naval stations.

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² The Unit Personnel consists of Commander A. P. Krueger, Medical Corps, Officer-in-Charge; Lieutenant L. E. Rosenberg, H-V(S); Lieutenant N. S. West, H-V(S); Lieutenant, junior grade, J. W. Hope, Medical Corps; Lieutenant, junior grade, A. H. Jacobs, Medical Corps; Lieutenant, junior grade, A. S. Browne, H-V(S); Lieutenant, junior grade, O. J. Golub, H-V(S); Lieutenant, junior grade, J. R. Mathews, H-V(S); Ensign H. M. S. Watkins, H-V(S); and Ensign G. B. Saviers, Hospital Corps, all of the United States Naval Reserve; Chief Pharmacist E. B. Mansfield, United States Navy, retired; Pharmacist I. L. Schechmeister; Pharmacist's Mate, first class, W. L. Axelrod; Pharmacist's Mate, first class, E. R. Chisholm; Pharmacist's Mate, second class, C. R. Webb, Jr.; Pharmacist's Mate, second class, H. R. Burkhead; and Pharmacist's Mate, third class, J. A. Gray, all of the United States Naval Reserve; and Hospital Apprentice, second class, D. D. Ments, United States Navy.

A full description of the unit's organization for conducting the vaccine tests has been given in an earlier paper (1).

Briefly the program entailed:

1. Establishment of sufficiently large vaccinated and control groups.
2. Development of suitable reporting procedures for such cases of influenza as might occur.
3. Provision of facilities for sending in blood serum specimens from suspected cases for serological confirmation of the clinical diagnosis.

Two vaccines were administered:

1. Type A virus vaccine developed by Horsfall, et al. (2) and supplied to us by the Rockefeller Foundation. It consisted of emulsified embryonic tissues from eggs infected with both type A influenza virus and the virus of canine distemper; the viruses were inactivated with formalin.

2. Type B virus vaccine prepared by the personnel of this activity in collaboration with Dr. Monroe D. Eaton and the staff of the Influenza Research Laboratory, California State Department of Public Health (3). The vaccine was made by harvesting the chorio-allantoic fluid from eggs infected with type B virus (Lee strain) and treating the fluid with formalin to inactivate the infectious agent.

Eight thousand three hundred and six men comprised the vaccinated group, all of whom received a single 1.0 cc. dose of type A virus vaccine injected subcutaneously in the deltoid region. At the time the type A vaccine was administered to 2,667 of these men we gave them a single 1.0 cc. injection of type B virus in the other arm. A somewhat larger unvaccinated control group (10,432) was established in order that the degree of protection afforded by the immunizing agents might be assessed, should an epidemic of influenza occur during the winter and spring of 1941-42.

TABLE 1.—*Twelfth Naval District*

	Station A	Station B	Station C	Station D	Total Twelfth District
Total men vaccinated "A".....	410	55	110	261	836
Total men vaccinated "B".....	153				153
Bled prior to vaccination.....	48	7	15	38	108

"A" VIRUS TITERS IN PERCENT

Negative.....	68.7	57.1	86.6	76.3	73.1
1:4.....	12.5	14.3		5.3	8.3
1:8.....	12.5	14.3	6.7	5.3	9.3
1:16.....	2.1	14.3		2.6	2.8
1:32.....	2.1			7.9	3.7
1:64.....	2.1			2.6	1.9
1:128.....			6.7		0.9
Anti-mouse.....					
Anti-complement.....					

"B" VIRUS TITERS IN PERCENT

Negative.....	100.0	100.0	100.0	97.4	99.1
1:4.....				2.6	.9

As it happened this period was singularly free from influenza in epidemic form and no addition to what is already known about the protective value of the agents tested can be derived from our studies. However, certain pertinent serological data were obtained from the blood specimens collected before and after vaccination of the men, and it is the purpose of the present paper to report these observations.

The efficacy of the vaccines in enhancing the titer of circulating antibodies was measured by performing complement-fixation tests upon pre- and post-immunization blood specimens. A general survey of pre-immunization titers was made on 994 sera or 12 percent of the vaccinated group. Second serum samples were taken 2 weeks after vaccination from 78 of the men who had received type A virus vaccine only and from 93 who had received both types A and B virus vaccine. Throughout these studies we have employed the method of Eaton and Rickard (4) for titrating complement-fixing antibodies.

Tables 1, 2, and 3 summarize the number of men vaccinated at the various stations, the number of blood specimens secured and the serological results obtained.

TABLE 2.—*Eleventh Naval District*

	Station E	Station F	Station G	Station H	Total Eleventh District
Total men vaccinated "A".....	3,254	1,065	1,194	1,957	7,470
Total men vaccinated "B".....	1,320	.....	1,194	.....	2,514
Bled prior to vaccination.....	329	106	83	368	986

"A" VIRUS TITERS IN PERCENT					
Negative.....	51.7	90.6	22.9	76.9	64.2
1:4.....	22.2	4.7	28.9	8.4	15.0
1:8.....	16.1	3.8	31.3	11.7	14.2
1:16.....	6.7	.9	8.4	1.9	4.2
1:32.....	.....	.....	.....	.....	.....
1:64.....	.....	.....	.....	.....	.....
1:128.....	.....	.....	.....	.....	.....
Anti-mouse.....	2.7	.....	8.4	1.1	2.2
Anti-complement.....	.6	.....	.....	.....	.2

"B" VIRUS TITERS IN PERCENT					
Negative.....	70.5	90.6	34.9	85.0	75.6
1:4.....	16.7	7.5	31.3	5.4	12.3
1:8.....	7.9	1.9	18.1	5.7	7.2
1:16.....	1.5	.....	7.2	.9	1.6
1:32.....	.....	.....	.....	.....	.....
1:64.....	.....	.....	.....	.....	.....
1:128.....	.....	.....	.....	.....	.....
Anti-mouse.....	2.7	.....	8.4	3.0	3.0
Anti-complement.....	.6	.....	.....	.....	.2

Considering first the totals for all areas (table 3) it appears that 71 percent of the individuals tested had no measurable titers of complement-fixing antibodies for type A influenza virus. Twelve percent gave positive reactions with 1:4 serum dilutions and 16 percent

exhibited titers beyond this dilution. Ordinarily only 2 percent to 5 percent of normals possess sufficient antibody to fix complement with A virus antigen in serum dilutions higher than 1:4 (5).

Eighty percent of the test group gave a negative titration for antibodies against type B virus. Eleven percent of the sera fixed complement at 1:4 dilution and 8 percent were positive in 1:8 or 1:16 dilutions.

TABLE 3.—*All areas*

Total men vaccinated with type "A" vaccine.....	8,306
Bled prior and two weeks subsequent to vaccination.....	171

"A" VIRUS TITERS IN PERCENT

	Pre-immunization	Post-immunization (2 weeks)		Pre-immunization	Post-immunization (2 weeks)
Negative.....	71.2	20.6	1:64.....	1.2	5.9
1:4.....	12.3	16.5	1:128.....	.5	1.2
1:8.....	9.8	24.7	Antimouse.....		1.2
1:16.....	3.1	24.7	Anticomplement.....		
1:32.....	1.8	5.3			

Total men vaccinated with both types "A" and "B" vaccines.....	2,667
Bled prior and two weeks subsequent to vaccination.....	93

"B" VIRUS TITERS IN PERCENT

Negative.....	79.5	41.9	1:64.....		
1:4.....	11.4	20.4	1:128.....		
1:8.....	6.8	21.5	Antimouse.....	1.2	2.2
1:16.....	1.2	14.0	Anticomplement.....		
1:32.....					

It is interesting to note the difference in normal antibody levels between personnel of group G, table 2, and other groups investigated. Sixty-eight percent of the former had measurable titers of type A antibody while the corresponding figure for the rest of the service personnel was 31 percent. This difference extends to the titration results for antibodies against type B virus. Fifty-seven percent of the personnel of group G, table 2, had some demonstrable titer of type B antibody as contrasted with an average of 18 percent for the remainder of the population tested. Since these data include the following serum dilutions, 1:4, 1:8, 1:16, it is probably more significant if the sera fixing complement in 1:4 dilutions are deleted and the positive group is limited to specimens fixing complement in 1:8 or 1:16 dilutions.

On this basis, personnel of the above group has 40 percent of positives against type A virus and 25 percent of positives against type B virus. The corresponding corrected figures for the remainder of the service personnel tested were 16 percent for type A virus and 6 percent for type B virus.

The differences noted above are significantly in favor of group G personnel and it is interesting to speculate on possible reasons why this should be so. A consideration of group G's composition may afford a partial explanation. This force at the time the survey was conducted was largely made up of men who had already spent considerable time in military service and its component units were relatively stable population groups. The adjacent Southern California community had been subjected to a moderately severe outbreak of influenza during 1940-41; there had been correspondingly high incidence rates of catarrhal fever and influenza among the group itself. The presence of influenza in such a series of semiclosed communities whose members were in continual close contact might be expected to result in a high percentage of serologically positive individuals.

A similar situation did not exist at the other stations visited. On the contrary the majority of the men had been recruited recently and were drawn together from widely separated areas throughout the United States. Many had lived in isolated rural districts where there was little opportunity to develop contact immunity to any of the communicable diseases and their service connection was of too brief duration for this to be remedied.

Following administration of the type A vaccine the group having no antibodies for this strain of virus was reduced from 71 percent to 21 percent. The percentage of sera active in dilutions higher than 1:4 rose from 17 to 62. With type B virus vaccine, the group completely lacking antibodies was lowered from 80 percent to 42 percent. Post-vaccination titers higher than the 1:4 dilution of serum were observed in 36 percent of cases as contrasted with 8 percent before the vaccine was given.

SUMMARY AND CONCLUSIONS

1. Complex type A influenza virus vaccine (supplied by the Rockefeller Foundation) was administered to 8,306 men at several different naval stations during the summer of 1941. Type B influenza virus vaccine prepared from the chorio-allantoic fluid of virus-infected eggs was given to 2,667 men. An unvaccinated control group comprising 10,432 men was established so that the efficacy of the vaccines in preventing influenza might be determined.

2. There was practically no influenza during the winter and spring of 1941-42, so no conclusions with respect to actual protective value of the vaccines can be drawn.

3. Complement fixation tests on 1,165 serum specimens from individuals in the test group showed that:

- (a) Prior to vaccination 71 percent had no antibodies for type A influenza virus and 80 percent had none for type B virus.

(b) Group G had a remarkably high incidence of positive sera. Only 23 percent had no type A antibody and 35 percent no antibody for type B virus, before the vaccine was administered.

(c) Administration of type A influenza virus vaccine lowered the percentage of individuals having no antibodies for this strain of virus from 71 percent to 21 percent. The postimmunization rise following injection with type B virus vaccine reduced the group completely lacking homologous antibodies from 80 percent to 42 percent.

4. While these serological data are of interest they do not necessarily prove that the development of antibodies implies existence of actual immunity against influenza.

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EXPERIENCES WITH FEVER THERAPY AT THE PHILADELPHIA NAVAL HOSPITAL¹

By WILLIAM H. H. TURVILLE, Captain, Medical Corps, United States Navy, and
FERDINAND FETTER, Lieutenant Commander, Medical Corps, United States
Naval Reserve.

GENERAL PRINCIPLES AND METHODS

Fever therapy is now old enough to permit a fairly accurate appraisal of its value. As happens with most new methods of treatment, fever therapy was originally hailed by the over-enthusiastic as a cure-all in a great variety of diseases. For example, Krusen and Elkins (1) in a review of the literature, found that fever therapy by physical means has been recommended for no less than 50 diseases, from adiposis dolorosa to undulant fever. At present, it seems that this form of treatment is of real value in not more than 10 diseases, of which

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gonococcal infections, neurosyphilis, and Sydenham's chorea head the list.

In general, the methods of producing fever therapeutically may be divided into two groups—the nonphysical and the physical. Artificially induced malaria illustrates one method of producing fever by nonphysical means; the use of a foreign protein parenterally illustrates another. The most widely used protein is typhoid or paratyphoid vaccine, given intravenously.

The development of the physical methods of producing fever began in the late twenties, in an effort to find more accurately controllable and less dangerous methods. Since then, great strides have been made in manufacturing apparatus which elevate the temperature with progressively greater safety and comfort for the patient. At present, most of these use one of two principles—exposure of the body to the type of wave used in short-wave diathermy, or exposure of the body in a cabinet to radiant heat. Some cabinets use dry heat, which may be luminous or nonluminous, and others use moist heat. Some apparatus combine the two principles, using short waves to elevate the temperature and radiant heat to maintain it. However, given a good apparatus for fever production, everyone working with physically produced fever has emphasized the fact that the skill and experience of the personnel giving the treatments is of much greater importance than the type of apparatus used.

EXPERIENCES AT THE PHILADELPHIA NAVAL HOSPITAL

The type of fever-producing apparatus that we have used at the United States Naval Hospital in Philadelphia is the hypertherm (formerly called the Kettering hypertherm). In this cabinet the patient's temperature is raised by surrounding his nude body with hot moist air. The cabinet temperature during the induction period is 115° to 120° F. After the patient's temperature reaches the desired level, the cabinet temperature can gradually be reduced to 107°–110°, and occasionally lower.

Pretreatment study.—It has been repeatedly emphasized that fever therapy is potentially dangerous, and should always be a hospital procedure. A patient must be in good health except for the disease for which he is being treated. Furthermore, he should be thoroughly studied to determine his fitness before being subjected to this type of treatment. In addition to a complete physical examination our patients have had the following studies done before fever therapy: Urinalysis, blood count, blood urea nitrogen, blood sugar, blood chlorides, electrocardiogram, chest x-ray, and blood sedimentation rate. The latter is determined because many of the diseases treated with fever are

accompanied by an increased sedimentation rate, and the return of this to normal is one of the indices of the success of fever therapy.

Management of a fever session.—The day before a treatment the patient is urged to drink water freely and is instructed to take sodium chloride. After a light supper he is given a soapsuds enema at 8 p. m. The morning of the treatment he has no breakfast but continues to take water freely. The treatment is started at about 7:30 in the morning.

During the treatment and preferably in the first 3 hours, the patient is given 20 grams of sodium chloride in water. After the induction period, which takes from 60 to 90 minutes, he is given a glass of water every 15 minutes, making a total of 4 to 5 liters during the treatment. He is also given 2 to 3 glasses of orange or other fruit juice, containing 1 tablespoonful of sugar to the glass. Carbonated drinks (ginger ale or cola drinks) may also be given if the patient wants them. Most patients feel more comfortable with $\frac{1}{8}$ grain of morphine sulfate hypodermically during the induction period, repeated in 2 or 3 hours if necessary. The temperature is observed constantly by an indicating thermometer, with a thermocouple in the patient's rectum, and recorded every 15 minutes, along with the pulse and respiration. The blood pressure is taken before starting the treatment, at the end of the induction period, and every 30 minutes thereafter. If the systolic pressure falls below 100 mm. of mercury, the patient is given $\frac{3}{8}$ grain of ephedrine sulfate by mouth, and the blood pressure is taken at 15 minute intervals. Occasionally 5 m 1:1000 solution of epinephrine hypodermically is needed as well as the ephedrine, if the response of the blood pressure to the latter is too slow.

After the patient is removed from the cabinet he is kept in the fever therapy department until his temperature is below 102°. When he returns to his bed, the temperature, pulse, and respiration are taken every 15 minutes until approximately normal. He continues to take liquid diet, and stays in bed for the rest of that day. Next day, he usually feels quite well, and can resume his normal diet and routine.

Complications of treatment and their management.—These may be divided into minor, intermediate, and major.

Minor complications:

1. Headache occurs in about one-third of the patients after treatment. It is usually mild, and is relieved by 5 to 10 grains of aspirin.
2. Herpes simplex of the lips occurs in about one-fourth of the patients. It is probably due to a virus already present in the skin of the face, which is activated by the fever. Compound tincture of benzoin or 5 percent ammoniated mercury ointment are fairly good prophylactics against herpes.
3. Erythema of the skin was relatively common in the early years of fever therapy but is a rare complication with the new hypertherms. Extra pads applied

to an area of the skin that shows early reddening will usually prevent a serious burn.

Intermediate complications:

1. Nausea and vomiting. If the patient is unable to take or retain the salt solution by mouth, it must be given parenterally during and after the treatment. We usually give 500 cc. of 5 percent glucose in 2 percent salt solution intravenously in such a case, followed by 1 or 2 liters of 5 percent glucose in normal saline solution. Occasionally intractable vomiting persists in spite of the intravenous salt and water. If this occurs the treatment should be discontinued.

2. Tetany is a rare complication, occurring during the induction period in less than 5 percent of patients. It is treated by the intravenous injection of 10 cc. of a 10 percent solution of calcium gluconate or chloride, repeated if necessary, or by the breathing of a 5 percent carbon dioxide—95 percent oxygen mixture. If these measures do not give relief, as they usually do, the treatment should be stopped. Patients who develop tetany once are apt to do so again in subsequent fever sessions. The daily administration of 3 to 4 grams of calcium gluconate or lactate between treatments helps to prevent a recurrence.

3. Delirium and hysteria. While most patients are rational and cooperative throughout a treatment, occasionally one will become delirious or hysterical. The apprehensive, high-strung individual is, of course, more subject to these complications than is the phlegmatic type. Reassurance by the nurse or medical officer before and during treatment will often prevent delirium and hysteria, or stop them once they have developed. If they persist, however, the treatment should be discontinued, as it is not safe to treat an irrational patient.

Major complications:

These are circulatory collapse, heatstroke, and convulsions. If any of these occurs, not only should the treatment be stopped at once, but further treatments should not be attempted.

1. Circulatory collapse, when it occurs, is of the peripheral vascular type. Signals that this is impending are: Systolic blood pressure below 80 mm. of mercury, pulse pressure below 20 mm. of mercury, or a cardiac rate of over 160 per minute. Should any of these occur, the treatment should be stopped, and the patient given 1 to 2 liters of 5 percent glucose in normal saline solution intravenously, and small doses of epinephrine, caffeine sodiobenzoate, or coramine. If the patient does not respond to these measures, oxygen inhalation or plasma transfusions are also indicated.

2. Heatstroke is characterized by a temperature of 108° F. (rectal) or higher, normal or increased blood pressure, coma, and cerebral or pulmonary edema. The treatment is, of course, discontinued at once, and the patient's temperature is reduced by sprinkling warm water over his body (cold water should not be used because it produces peripheral vasoconstriction and thus prevents heat loss), and fanning him with 2 or 3 electric fans. An ice water enema should be given if these measures do not cause a prompt fall in temperature. 100 to 200 cc. of 50 percent glucose or sucrose solution should be injected intravenously. A spinal puncture may be necessary if cerebral edema develops, and occasionally venesection must be done because of pulmonary edema.

3. Convulsions may occur in patients with organic brain disease. They are therefore seen most often in patients with dementia paralytica or meningovascular syphilis. They may be the first sign of a cerebral vascular accident. Sodium amytal intravenously, in doses of 3¾ to 7½ grains, is the best drug for controlling convulsions. Occasionally intravenous evipal or pentothal sodium is necessary, as is a spinal tap and the intravenous injection of 100 cc. of a 50 percent solution

of glucose or sucrose. The patient should be watched closely for a recurrence of the convulsions during the next 24 to 72 hours.

By applying the maxim, "If in doubt, take him out," we have managed to avoid any of the major reactions, and have not had any deaths as a result of fever therapy. We cannot overemphasize the seriousness of the three severe reactions described above, and the necessity of prompt and vigorous treatment once they occur. It is only by terminating treatments before these catastrophic reactions occur that deaths from fever therapy can be avoided.

ANALYSIS OF CASES TREATED

From July 1, 1940 to July 1, 1941, we gave 316 treatments to 63 patients. During the next year, from July 1, 1941 to July 1, 1942, we gave 785 treatments to 110 patients. The 2 years' experience is summarized in table 1.

TABLE 1.—Summary of cases treated

Diagnosis	Number of cases	Service status		Average number treat-ments	Temperature range (° F.)	Hours per treatment	Results				
		Active	Inactive				Completed				Not com-pleted
							Cure	Much im-provement	Slight im-provement	No change	
Gonorrheal urethritis.....	50	50	0	5	106-107	6	31	2	—	1	16
Arthritis, gonococcal.....	6	5	1	6	106-107	6	2	—	—	—	2
Neurosyphilis.....	46	10	36	10	105-106	5	—	23	5	4	14
Arthritis, rheumatoid.....	37	11	26	7	104-105	4	—	17	6	7	7
Asthma.....	11	6	5	4	104-105	3	—	8	3	—	—
Rheumatic fever.....	5	1	4	8	105-106	4	—	4	—	1	—
Multiple sclerosis.....	5	0	5	8	104-105	5	—	—	1	—	4
Subacute bacterial endocarditis.....	3	1	2	10	103-105	4	—	—	—	3	—
Dermatitis, chronic (etiology un-known).....	1	0	1	8	104-105	3	—	—	1	—	—
Prostatitis, chronic, non-venereal.....	3	3	0	4	105-106	5	1	—	—	—	2
Post-encephalitic Parkinsonism.....	2	0	2	4	105-106	4	—	—	—	—	2
Paranoid personality.....	1	0	1	1	104-105	3	—	—	—	—	1
Spastic quadriplegia.....	1	0	1	1	104-105	4	—	—	—	—	1
Bell's palsy.....	1	0	1	10	104-105	5	—	1	—	—	—
Neuritis, multiple.....	1	1	0	10	104-105	3	—	—	1	—	—
Total.....	173	88	85	—	—	—	124				49

Gonococcal infections.—As seen in the table the largest number of patients treated, 56, had gonococcal infections. All but one of these were active service patients. Six of these had arthritis, and the other 50 had urethritis. All of these patients had had one or more courses of sulfonamide therapy without cure before being given fever therapy. In this series the patients were not given fever and chemotherapy simultaneously, although the experience of Simpson and his coworkers (2) indicates that this is probably the quickest method of obtaining a cure in drug-resistant cases. However, of 38 patients who completed their treatments, 87 percent were cured. In the

treatment of active service patients, the greatest sphere of usefulness of fever is in sulfonamide-resistant gonococcal infections. The desirability of a rapid cure and quick return to duty of these patients is obvious.

Neurosyphilis.—Our next largest group of patients, 46, had neurosyphilis. Most of these were cases of dementia paralytica. Our results, improvement in 71 percent of the 32 patients who completed treatment, compares favorably with those reported in the literature (3). We also found, as have others, that clinical improvement after fever therapy usually preceded serological improvement.

Rheumatoid arthritis.—37 of the patients were treated for rheumatoid arthritis. Of the 30 patients completing treatment, 17, or 56 percent, were significantly improved. Better results were obtained in treating patients in the acute stage of the disease than in the chronic stage. These results are similar to those reported previously by one of us (4).

Asthma.—Of 11 patients treated for bronchial asthma, 8, or 73 percent, were much improved. All of these patients had been treated more or less unsuccessfully by the usual methods before being given fever therapy. Our results are somewhat better than those reported in the literature (5).

Rheumatic fever.—Of five patients treated for rheumatic fever, four were definitely improved. The chief value of fever therapy in this disease is in the subacute, prolonged type of rheumatic infection.

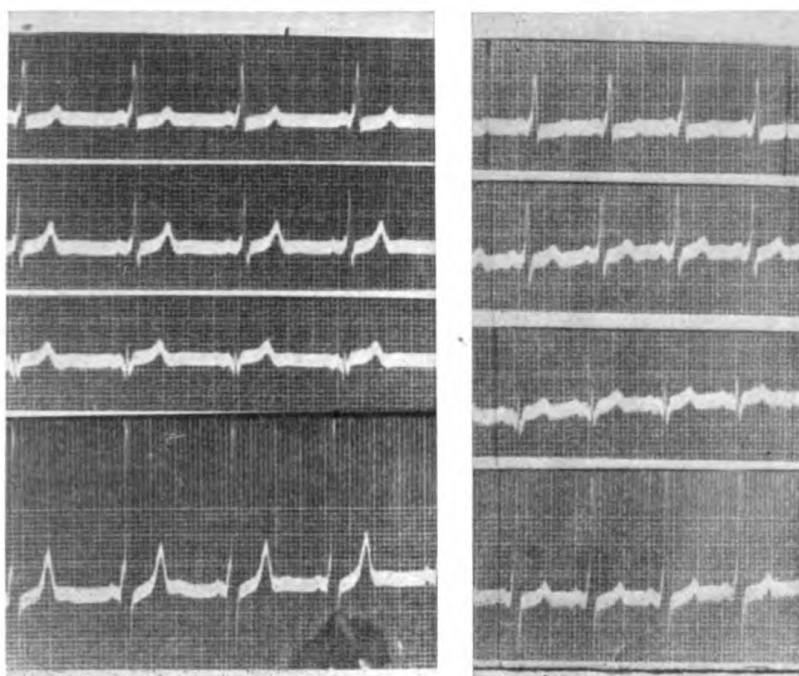
Subacute bacterial endocarditis.—The three patients treated for this disease were not benefited. Sulfonamide therapy was used along with fever therapy. However, on the basis of Bierman's (6) (7) experiences, we believe that combined fever and chemotherapy merits further consideration in this highly fatal disease.

Miscellaneous diseases.—In the other diseases listed in the table, we used fever therapy more or less experimentally, and because there was nothing else definite to offer the patient. Of these, we think that fever therapy deserves a trial in multiple sclerosis and in certain types of dermatitis not responding to other methods of treatment.

On the basis of our experience we believe that fever therapy is the treatment of choice in sulfonamide-resistant gonococcal infections and in dementia paralytica. It is a valuable adjunctive treatment in selected cases of rheumatoid arthritis, asthma, and prolonged rheumatic infections. It deserves further study in subacute bacterial endocarditis, multiple sclerosis, and various dermatoses. Because children are not admitted to the Naval Hospital in Philadelphia, we have not had any cases of Sydenham's chorea to treat, nor, as it happens, of brucellosis or of the vasospastic type of peripheral vascular disease. However, the previous experience of one of us and of

others (8) (9) shows that fever is of great value in treating patients with these diseases.

Patients not completing treatment.—Forty-nine of the 173 patients, 28 percent, did not complete enough treatment for the results to prove anything. In 3 of these cases, treatments were discontinued because of severe hysterical reactions, and in another 3 because of tetany. In the remaining 43 patients the treatments were not completed because of lack of cooperation. This seems a fairly large number of uncooperative patients. However, we made little effort to coerce unwilling patients, feeling that attempts at treatment without cooperation can often lead to serious complications and disasters. We believe that our lack of catastrophes more than offsets the relatively high percentage of uncompleted treatments.



1A. NORMAL PRE-FEVER TRACING TAKEN 1/27/42 OF T. G., AGE 17 YEARS, TREATED FOR GONORRHEAL URETHRITIS.

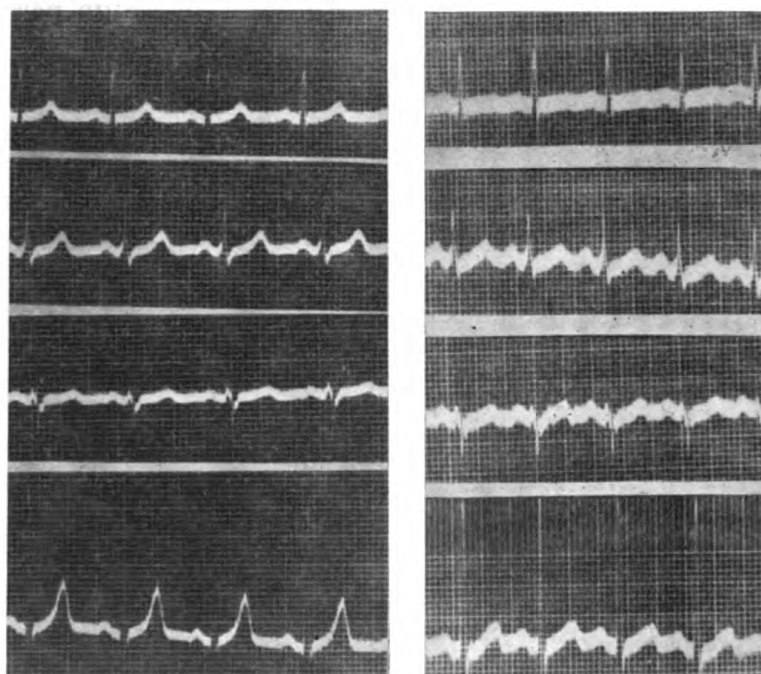
1B. TRACING TAKEN 2/24/42 OF THE SAME PATIENT, AT THE END OF A FEVER SESSION, SHOWING DECREASE IN AMPLITUDE OF THE T-WAVES IN LEADS 1, 2, AND 4.

ELECTROCARDIOGRAPHIC STUDIES DURING FEVER THERAPY

In 13 cases, electrocardiograms were taken at the end of the fever session, and were compared with the prefever electrocardiogram, to determine if the elevated temperature had changed the tracing. None of these patients had any evidence of heart disease, and all had normal electrocardiograms before treatment. In 6 of the patients, the post-fever tracing remained entirely normal. In 2 of the patients very questionable changes occurred, consisting of slight decrease in the

amplitude of the T-wave in lead 1. In the other 5 patients the post-fever tracing differed definitely from that recorded before fever. The changes, which were rather similar in all of these cases, consisted of decrease in the amplitude of the T-wave in lead 1 in all cases, and of T_1 and T_2 or T_4 in 3 cases. In none was the decrease in amplitude enough to produce isoelectric or inverted T-waves, but it was enough to produce definitely low-voltage T-waves.

We were unable to correlate the electrocardiographic changes with the age of the patient, the height of the fever, or with the cardiac rate. Patients in both groups ranged in age from the late teens to 45 years. Patients treated above and below 106° F. were present in both groups, and the degree of tachycardia was about the same in both groups.



2A. NORMAL PRE-FEVER TRACING TAKEN 1/27/42 OF J. C., AGE 45 YEARS, TREATED FOR DEMENTIA PARALYTICA.
2B. TRACING TAKEN 3/2/42 OF THE SAME PATIENT, AT THE END OF A FEVER SESSION, SHOWING DECREASE IN AMPLITUDE OF THE T-WAVES IN LEADS 1 AND 4.

The consensus in the literature (10) (11) is that electrocardiographic changes as a result of fever therapy are not frequent, are of little significance, and are at least partly attributable to the increase in cardiac rate. Our short series indicates that they are more common than has been thought, and points to the necessity of constant watch of the cardiovascular system during a fever session. It also emphasizes the importance of terminating a treatment at the earliest sign of cardiovascular failure, e. g., a cardiac rate of 160 per minute, or a systolic blood pressure below 90 mm. of mercury, rather than waiting for serious symptoms before removing the patient from the cabinet.

STUDIES OF BLOOD CHLORIDES AND NONPROTEIN NITROGEN

In 11 patients, blood chlorides and nonprotein nitrogen were determined before and immediately after a fever treatment. In 4 of the patients, the determinations were made during 2 fever sessions; in the 7 others, the determinations were made during 1 fever session only. The normal range for blood chlorides according to the technic used was 450 to 520 milligrams percent, and for the nonprotein nitrogen, 25 to 35 milligrams percent.

The results are shown in table 2.

TABLE 2.—*Blood chlorides and nonprotein nitrogen before and after fever therapy*

Patient	Blood chlorides (mg. percent)		Nonprotein nitrogen (mg. percent)	
	Before fever	After fever	Before fever	After fever
L. C.	462	447	22.5	28
Do.	445	453	30	21.4
G. S.	470	502	40.9	34.6
Do.	498	440	25.7	24
L. S.	511	478	23.6	28.1
Do.	430	448	35	24.6
A. W.	478	494	25	35
Do.	447	488	26.4	30.1
J. C.	495	462	20.4	20.4
A. D.	495	441	25	23.6
T. G.	511	511	32.1	28.1
H. H.	478	445	23.6	22.5
B. L.	478	449	28.1	23.6
R. McA.	462	455	35	27.5
J. R.	462	462	23.6	25

As seen in the table, the blood chlorides were decreased eight times, increased five times, and remained unchanged two times. The nonprotein nitrogen was decreased nine times, increased five times, and remained unchanged once.

There are a variety of factors that affect these chemical constituents of the blood during a fever session. The marked loss of water from the skin by sweating and from the lungs by the increased respiratory rate, tends to concentrate the blood and increase the chlorides and the nonprotein nitrogen. The increase in the rate of excretion of sodium chloride and urea from the skin during a treatment tends to decrease the concentration of these substances in the blood. These conflicting factors are further complicated by the administration of salt and water during a treatment, the former tending to increase the blood chlorides, and the latter tending to decrease both the chlorides and the nonprotein nitrogen.

Our findings confirm those of Neymann (12), of the lack of constancy and significance of the changes in the blood chlorides and nonprotein nitrogen during fever therapy. The conclusion from our studies is that, provided a patient takes and retains the prescribed

amount of salt and water during a treatment, the chlorides and non-protein nitrogen will remain within normal limits, and one need not fear that either hypochloremia or nitrogen retention will occur.

SUMMARY AND CONCLUSIONS

During the 2-year period from July 1, 1940 to July 1, 1942, we gave 1,101 fever treatments to 173 patients at the Naval Hospital in Philadelphia.

Of 38 patients treated for gonococcal infections, 87 percent were cured. Significant improvement occurred in 71 percent of 32 patients treated for neurosyphilis; in 56 percent of 30 patients treated for rheumatoid arthritis; in 73 percent of 11 patients treated for bronchial asthma; and in 80 percent of 5 patients treated for rheumatic infection.

On the basis of our experience, we believe that fever therapy is the treatment of choice in sulfonamide-resistant gonococcal infections and in dementia paralytica, that it is a valuable adjunctive treatment in selected cases of rheumatoid arthritis, asthma, and prolonged rheumatic infections, and that it deserves further study in subacute bacterial endocarditis, multiple sclerosis, and various dermatoses.

On the basis of the study of electrocardiograms taken before and after treatment in 13 patients, we find that T-wave changes in leads 1, 2, and 4 occur in an appreciable number of patients. This emphasizes the importance of a very close watch of the patient's cardiovascular system during a treatment.

On the basis of studies of the blood chlorides and nonprotein nitrogen before and after treatment in 11 patients, we find that, if a patient takes and retains the prescribed amount of salt and water during a treatment, there is no danger of either hypochloremia or nitrogen retention occurring.

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EXAMINATION OF THE HEART IN NAVY APPLICANTS¹

By H. E. UNGERLEIDER, M. D.; T. F. DUHIGG, Lieutenant Commander, Medical Corps, United States, Navy, Retired; and R. S. GUBNER, M. D.

The cardiac aspect of the examination of candidates for military service is concerned essentially with determining whether organic heart disease is present. Heart disease is often perfectly compatible with normal activity, even for the strenuous physical demands occasioned by service in the armed forces. However, because of the eventual limitations, which tend to develop in most types of heart disease, it is not deemed advisable to accept subjects with definite heart disease for active service, since permanent obligations are assumed by the government for its military personnel. Experience with veteran disability following the first world war has dictated more rigid standards for selection. This is all the more necessary at the present time because the increased needs for manpower have broadened the age limits for service. Below the age of thirty, 80 to 90 percent of heart disease is rheumatic in origin, but beyond the third decade luetic, hypertensive and even arteriosclerotic heart disease occur with greatly increasing frequency, so that actually one encounters all varieties of heart disease among recruits.

The problems in examination of the heart are somewhat different from those in civil practice and are perhaps more akin to the selection of applicants for insurance. One deals not with the individual but with large groups, so that the significance of various findings must be evaluated in statistical terms with a long-range outlook, whereas in clinical practice the emphasis is on the immediate rather than the remote future. A greater dependence must be placed on the objective findings in examination, since even though organic disease is present,

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there may not be any symptoms or the history may be incomplete, while in civilian medicine it is the symptoms which usually bring the patient to the physician and provide a most important guide to diagnosis.

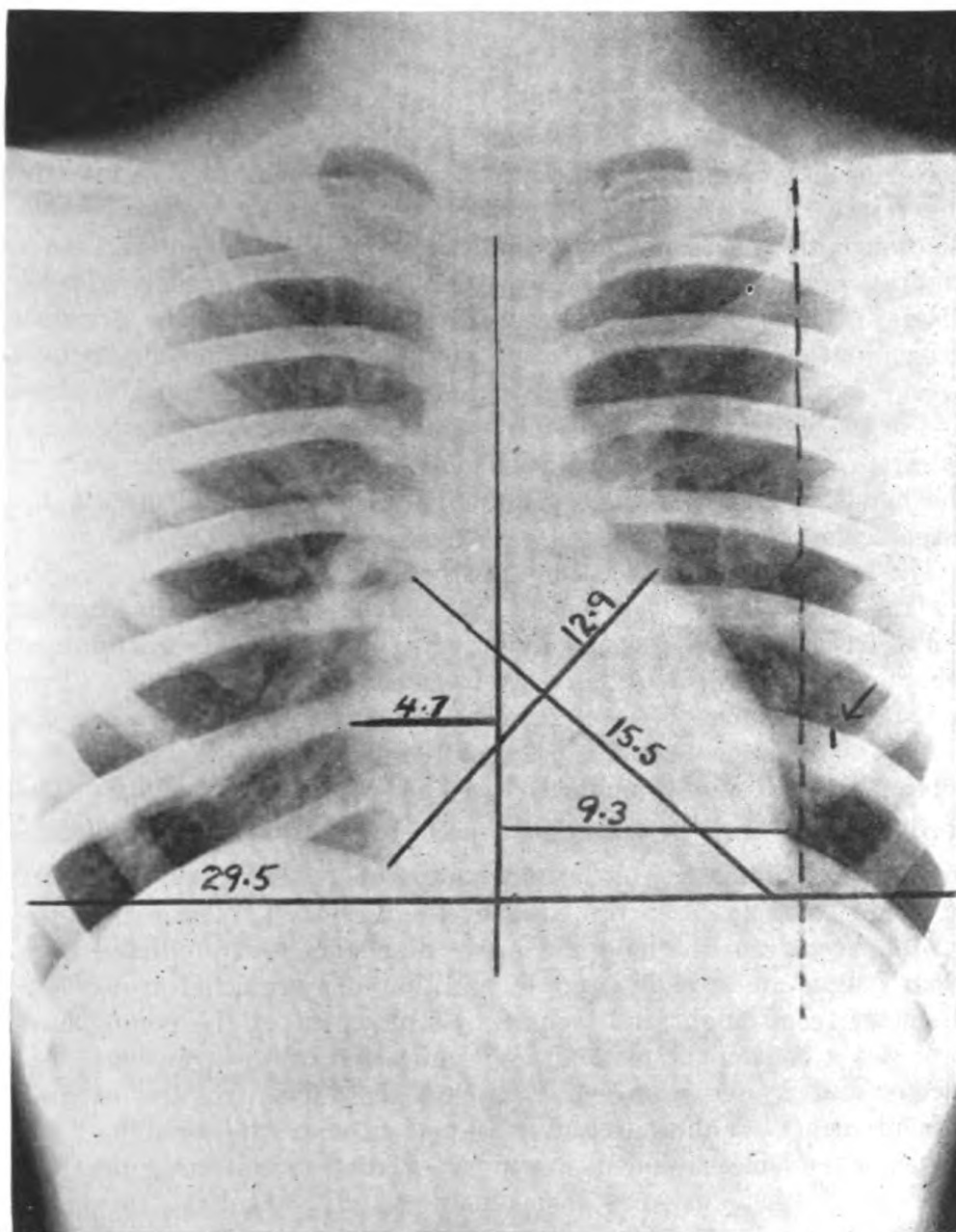
This report is based on experience derived from examination of cardiac suspects among applicants at the United States Navy Recruiting Station in New York City, referred for examination to the diagnostic laboratory of the Equitable Life Assurance Society of the United States. It is not designed as an all-inclusive survey of the military aspects of heart disease, but is intended, rather, to point out certain considerations of practical interest in the interpretation of various findings in the examination of the heart.

THE HEART SIZE

Enlargement of the heart is accepted as an unequivocal sign of organic heart disease. Significant enlargement of the heart does not usually occur as an isolated finding, but in conjunction with other abnormalities, such as elevation of the blood pressure or valvular lesions as evidenced by murmurs. When heart disease is suspected but the findings are equivocal, the demonstration of cardiac enlargement provides important evidence that organic heart disease exists (fig. 1).

Ordinarily the size of the heart may be estimated reasonably well by physical examination. The position of the apex gives a fair indication of the size of the left ventricle. Enlargement of the other chambers cannot be reliably discerned on physical examination except in advanced stages, but it is the left ventricle which is the chamber most frequently involved by the commoner types of heart disease. The apex is best located by the left-most point at which a definite forward impulse is imparted to the palpating finger. The position of the apex is most frequently referred to the nipple line, but this is a less dependable reference point than a line dropped from the mid-point of the clavicle. The nipple line often coincides with the mid-clavicular line but its location is quite variable and it may be situated considerably outside the midclavicular line even in young male subjects of normal development (fig. 1), while in those of heavy build and in females the position of the nipple line is even more variable.

Except in obvious cases of enlargement it is advisable to check physical findings by roentgen examination. Fluoroscopy is the most convenient and generally available technic and ideally should be performed as a preliminary to any further roentgen study. The individual cardiac chambers may be inspected in the entirety of their contours by rotation into the oblique views. Thus on rotation into the left anterior oblique position, the left ventricle should clear the anterior border of the spine at an angle of about 60°, and left ven-



1. F. H. W., AGE 19, WEIGHT 145, HEIGHT 5 FT., 8½ IN. HISTORY AND PHYSICAL EXAMINATION WERE NEGATIVE EXCEPT FOR THE FINDING OF A BLOOD PRESSURE OF 158/56, WHICH LED TO SUSPICION OF AORTIC INSUFFICIENCY. A SOFT SYSTOLIC MURMUR WAS PRESENT AT THE BASE BUT NO DIASTOLIC MURMUR COULD BE HEARD OVER THE AORTIC AREA. PREDICTED TRANSVERSE DIAMETER OF HEART IS 12.3 CM.; ACTUAL TRANSVERSE DIAMETER IS 14.0 CM., 15 PERCENT ABOVE THE PREDICTED. THE FRONTAL CARDIAC AREA IS 156 SQ. CM., WHICH EXCEEDS THE PREDICTED FRONTAL AREA OF 122 SQ. CM., BY 28 PERCENT. THESE MEASUREMENTS INDICATE DEFINITE CARDIAC ENLARGEMENT, SINCE NORMALLY THEY SHOULD NOT EXCEED PREDICTED VALUES BY MORE THAN 10 PERCENT.

THE CARDIO-THORACIC RATIO $\frac{(\text{T. D. OF HEART})}{(\text{INTERNAL T. D. OF CHEST})}$ IS NORMAL (47 PERCENT). THIS IS THE POOREST OF ALL CARDIAC MEASUREMENTS AND SHOULD BE DISCARDED. NOTE, TOO, THAT THE LEFT HEART BORDER LIES WITHIN THE MID-CLAVICULAR LINE DESPITE THE DEFINITE ENLARGEMENT, AND THAT THE MID-CLAVICULAR AND NIPPLE LINE (INDICATED BY ARROW POINTING TO LEAD MARKER) DO NOT COINCIDE.

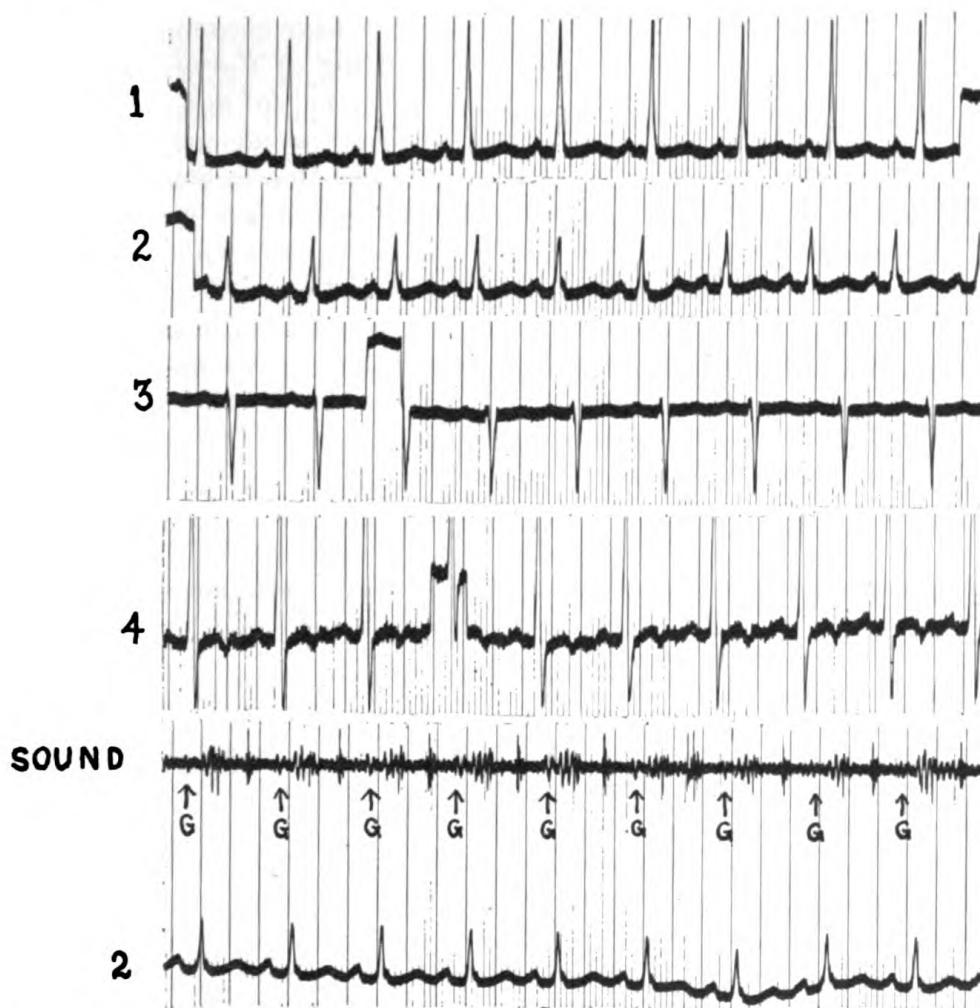
tricular enlargement is present if any considerably greater rotation toward the left lateral position is required to clear the spine. In the right anterior oblique or right lateral position early enlargement of the left atrium may be detected by backward projection of the posterior heart contour, which is formed by the left atrium, into the retrocardiac space. This is best recognized by backward displacement of the esophagus visualized with thick barium mixture, and this procedure should always be carried out when mitral valvular disease is suspected. Fluoroscopy is not well suited for the absolute determination of heart size, except when the orthodiagraphic technic is employed, because of the projection distortion and magnification due to the short focal distance. Orthodiascopy permits a very accurate reproduction of the cardiac shadow but it is dependable only in the hands of a well-trained examiner and it is not well suited for large scale use.

The teleroentgenogram is the most practical method for determining the heart size. Measurements are valuable to establish whether the heart size exceeds normal limits when it is not readily apparent whether the heart is of normal size or definitely enlarged. Two measurements suffice for the estimation of heart size. These are the transverse diameter and the area of the frontal cardiac silhouette, related to prediction standards based on weight and height. The cardiac area may be calculated accurately from the product $\frac{\pi}{4}$ long \times broad diameters, obviating the need for planimetry. A chart of nomograms has been prepared by the authors (1) indicating the cardiac area from the long and broad diameters, and predicted area from height and weight, and in addition the predicted transverse diameter from height and weight. Employment of the nomograms provides a convenient method for application of the transverse diameter and frontal area, which are the most useful of the cardiac measurements. Values exceeding 10 percent above the predicted for either of these measurements are to be regarded as indicating that the heart is enlarged, since few normal subjects fall beyond this range.

HEART SOUNDS

The quality of the heart sounds undergoes characteristic changes in various conditions, such as accentuation of the aortic second sound in hypertension, increased intensity of the pulmonic second sound in mitral disease, weakened first sound at the apex in myocardial disease, and the snapping first sound at the apex in mitral stenosis. Practically, however, the heart sounds by themselves are not of great diagnostic importance, although any abnormalities, such as the snapping first sound typical of mitral stenosis, should lead to careful search for further evidence of heart disease.

Extra heart sounds occur not infrequently and there may be some difficulty in interpreting their significance. True gallop rhythm, when the tripling of the heart sounds is due to an extra sound in



2. A. K., AGE 31. MECHANIC LEADING VERY ACTIVE LIFE, UNAWARE OF ANY HEART DISEASE. BLOOD PRESSURE 170/116, CARDIAC ENLARGEMENT OBSERVED ON FLUOROSCOPY. ELECTROCARDIOGRAM PRESENTS TYPICAL PATTERN OF LEFT VENTRICULAR STRAIN (LEFT AXIS DEVIATION ASSOCIATED WITH HIGH VOLTAGE OF THE QRS COMPLEX AND LOW AMPLITUDE OF THE T WAVE IN LEAD 1). T WAVE IS INVERTED IN THE PRECORDIAL LEAD INDICATIVE OF MYOCARDIAL INVOLVEMENT.

A DEFINITE PRESYSTOLIC GALLOP RHYTHM WAS HEARD WHICH IS RECORDED IN THE STETHOGRAM. THE GALLOP SOUND (G) IS SYNCHRONOUS WITH AURICULAR CONTRACTION (P WAVE).

diastole, is a sign of serious cardiac weakness. This is rarely encountered in the examination of presumably healthy subjects, such as naval applicants, although such an instance is illustrated in figure 2, where a presystolic gallop was present in association with severe hypertensive heart disease, of which the subject was entirely unaware. The extra sound in protodiastolic or presystolic gallop is

merely an accentuation of a sound which may be present normally in association with rapid ventricular filling in early diastole (third heart sound, protodiastolic gallop), or in late diastole at the time of auricular contraction (auricular sound, presystolic gallop).

The usual types of extra cardiac sounds we have encountered in the examination of applicants have been splitting of the normal heart sounds and mesosystolic clicks. Neither of these is of any significance as a rule, although rarely splitting of the heart sounds may be caused by asynchrony in contraction of the ventricles due to bundle branch block. Extra sounds which occur during systole are generally regarded as of extra-cardiac origin and may be due to such adventitious causes as pericardial adhesions. Characteristically they are heard near the apex shortly following the first heart sound or in mid-systole; they are of a sharp grating quality and resemble a click more than the heart sounds. Such sounds tend to vary considerably and may disappear with changes in position or during phases of respiration. Examples of systolic clicks are illustrated in figure 3.



TWO CASES ILLUSTRATING MESO-SYSTOLIC CLICKS, INTERPOSED BETWEEN THE FIRST AND SECOND HEART SOUNDS.

HEART MURMURS

Murmurs are encountered more frequently than any other abnormal finding in the examination of the heart and it is difficult and at times impossible to interpret their significance accurately. The more important factors to be considered are:

1. Is any murmur present? It is essential to listen for murmurs both in the recumbent and erect positions and immediately after brisk exercise as well as at rest.

2. Is the murmur systolic or diastolic in time? When the heart rate is slow, there is ordinarily little difficulty in timing murmurs but with rapid rates there may be some uncertainty as to its time in relation to the cardiac cycle. The second heart sound is ordinarily easily distinguished from the first at the base, and it is advisable whenever there is difficulty in timing sounds or murmurs at the apex to reverse the usual process in auscultation and listen first at the base to become clearly oriented as to the timing of the heart sounds and then gradually shift the stethoscope down toward the apex.

3. What are the characteristics of the murmur as regards location, area over which it is heard, its duration, loudness, quality, relation to respiration, and effect of exercise and change in body position?

4. Are there any associated findings, such as abnormalities in the blood pressure, evidence of cardiac enlargement, etc?

SYSTOLIC MURMURS

Apical systolic murmurs occur in all types of organic heart disease and not infrequently in normal subjects as well. In the younger age groups organic apical systolic murmurs are almost always due to rheumatic mitral insufficiency. The differential diagnosis between functional and organic apical systolic murmurs has been the subject of numerous studies, yet there is no specific distinguishing sign. There are certain considerations which are helpful in evaluating the significance of an apical systolic murmur. A history of rheumatic fever is to be regarded adversely since mortality studies show that life expectancy is appreciably less when there is a history of rheumatic fever in association with the finding of an apical systolic murmur. Thus it was found in an extensive follow-up study of insurance applicants (2) that the ratio of $\frac{\text{actual}}{\text{expected}}$ mortality in subjects with an apical systolic murmur without other impairments was 192 percent, whereas when there was in addition a rheumatic history, the mortality ratio increases greatly to 337 percent. In normal subjects the ratio $\frac{\text{actual}}{\text{expected}}$ mortality is 100 percent.

Levine (3) has stressed the loudness of apical systolic murmurs as a direct index of its significance. Faint apical murmurs or murmurs which are heard only transiently after brisk exercise are of little consequence, whereas systolic murmurs of moderate intensity or more are

suggestive of organic mitral insufficiency. This distinguishing feature is not absolute for cardiorespiratory murmurs, and functional systolic murmurs may occasionally be quite loud particularly in slender subjects with thin chest walls. Apical systolic murmurs are to be regarded with greater suspicion in subjects of normal development than in those of asthenic habitus, or where the sternum is depressed or the thorax of unusual configuration. Cardiorespiratory murmurs are extracardiac in origin and are due to suction of air into the lung-field adjacent to the apex caused by the increased negative pressure resulting from ventricular emptying in systole. This murmur is markedly accentuated during slow inspiration and diminished or disappears when respiration is suspended. Functional murmurs tend to vary to a greater degree than organic apical systolic murmurs with change in body position, and may increase or diminish on changing to the recumbent position, whereas the murmur of mitral insufficiency is always louder in the recumbent position when the subject lies on his left side. Functional as well as organic murmurs are accentuated by exercise so that this is of little practical value in interpreting the significance of apical systolic murmurs, although exercise is of great value in eliciting diastolic murmurs and systolic murmurs at the aortic area.

The duration of the murmur is just as significant as is its intensity. Murmurs which extend throughout systole and occupy the entire period between the first and second heart sounds are to be regarded as organic, all the more so when the murmur tends to replace the first heart sound. The quality of the murmur is less important than its loudness and duration. Infrequently there may be heard a high-pitched musical systolic murmur which tends to be louder near the sternum in the fourth interspace than at the apex. Such murmurs should be regarded as of organic origin and may be indicative of some morphological abnormality in the region of the mitral valvular ring.

When there is any question regarding the significance of an apical systolic murmur, fluoroscopic examination should be performed and the esophagus should be outlined with thick barium mixture and studied in the right anterior oblique position. Backward displacement of the esophagus is pathognomonic of enlargement of the left atrium and is most important corroborative evidence that mitral valvular disease exists.

Systolic murmurs at the base over the pulmonic or aortic area occur very commonly in young normal subjects and unless the murmur is loud it may be disregarded. Basal systolic murmurs in young subjects are rarely due to organic disease although rarely they may be due to aortic stenosis or various congenital heart lesions, such as patent ductus arteriosus, patent interventricular or interatrial septum or

pulmonic stenosis. Even with the aid of roentgen and electrocardiographic study it is frequently difficult to decide whether systolic murmurs at the base are due to organic heart disease or are of functional origin. Such findings as right axis deviation in the electrocardiogram and prominence of the upper left heart border in the region of the pulmonary artery, may be present normally in slender subjects and do not necessarily indicate right ventricular strain consequent to rheumatic or congenital heart disease.

Beyond the fourth decade a systolic murmur at the base over the aortic area cannot be so lightly dismissed as in younger subjects since it frequently indicates widening of the aorta and aortic valvular involvement due to hypertension, luetic aortitis, or arteriosclerosis.

DIASTOLIC MURMURS

Diastolic murmurs at the apex or base are always indicative of organic disease and the difficulty is not one of interpreting but rather of eliciting these murmurs. Mitral stenosis usually develops at a later stage than mitral insufficiency but the typical presystolic rumble and snapping first sound of mitral stenosis may be present in the absence of any systolic murmur. The short presystolic murmur of mitral stenosis is heard with difficulty in the erect position and for this reason examination of the heart should always include careful auscultation in the recumbent position with the subject lying on his left side, particularly if there is a loud snapping quality of the first heart sound suggesting the possibility of mitral stenosis. The presystolic murmur of mitral stenosis, as is well recognized, may be localized to a small area and may be heard distinctly only after exercise. In more advanced stages of mitral stenosis the murmur is louder and of longer duration and there may be an early diastolic rumble which may merge with the presystolic murmur to give rise to a long diastolic murmur. This type of murmur is rarely encountered among applicants, and the early signs of mitral stenosis must be sought if this lesion is to be found. A presystolic thrill is usually described as a typical finding in mitral stenosis but this likewise is an advanced sign and is of no practical diagnostic value.

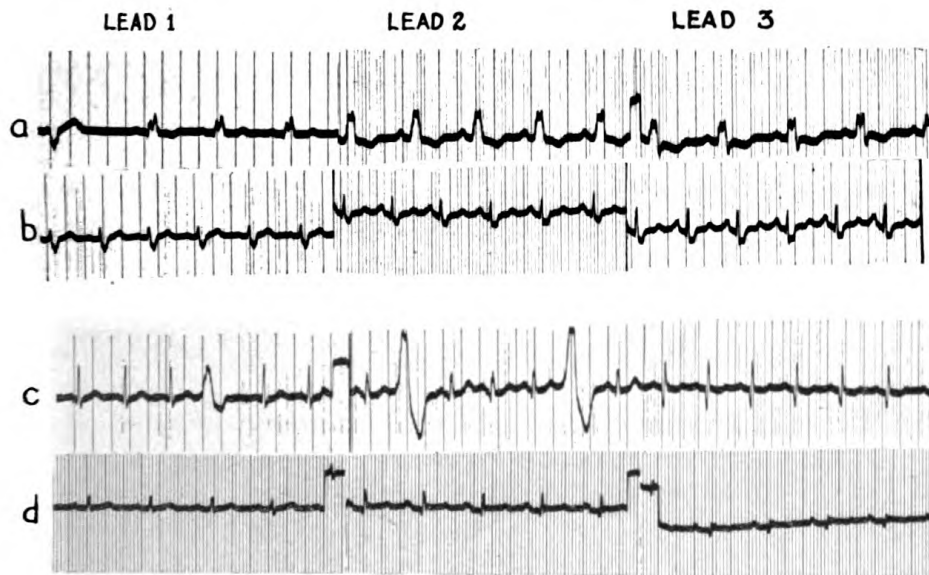
The diastolic murmur of aortic insufficiency in our experience is the most readily overlooked of all heart murmurs. Aortic insufficiency is not at all a rare lesion and frequently occurs without any associated mitral valvular disease. It is perfectly compatible with vigorous physical activity for many years, and most of the subjects we have observed with this lesion have been actively engaged in strenuous work entirely unaware that their hearts were in any way abnormal. The murmur is heard best with a large diaphragm

chest piece with the subject leaning or sitting forward, inclined from the hips with the spine held straight, and with respiration suspended after a deep expiration. The murmur is heard in the first and second right intercostal spaces and frequently may be heard more clearly in the third or even fourth left intercostal space at the sternal border. It is a soft and relatively short murmur akin to a faint whiff following the second heart sound. Whenever the second sound at the aortic area is not sharp, this murmur should be carefully sought. Another finding which should lead to careful auscultation for the murmur of aortic insufficiency is widening of the pulse pressure. The characteristic changes in the blood pressure with high systolic and very low diastolic levels, Corrigan pulse, Duroziez's sign, capillary pulsations, etc., are seen only in advanced stages of aortic insufficiency. In the earlier stages of aortic insufficiency found among applicants, none of these phenomena occurs and the only abnormality which is nevertheless important, is a slight widening of the pulse pressure with a relatively normal systolic and low diastolic level, often between 50 and 70 mm. Hg. In several cases with definite aortic insufficiency we have found the blood pressure to be quite normal. Whenever aortic insufficiency is suspected, roentgen examination should be carried out to establish whether there is any cardiac enlargement, for demonstration of left ventricular enlargement provides confirmatory evidence of the presence of aortic insufficiency. Such a case is illustrated in figure 1. Even though the heart is of normal size, the blood pressure normal, and the cardiac reserve obviously good, the finding of an aortic diastolic murmur of itself suffices for the diagnosis of aortic insufficiency. On the other hand, occasionally a murmur cannot be demonstrated, yet widening of the pulse pressure and cardiac enlargement provide presumptive evidence that this lesion is present. Any well-grounded suspicion that aortic insufficiency exists indicates rejection for military service. While this lesion is compatible with many years of normal vigorous activity, it leads to progressive cardiac enlargement over a period of time with ultimate rapid impairment of the cardiac reserve.

ARRHYTHMIAS

Actuarial mortality studies have indicated a prohibitively high mortality when the heart rate is persistently more rapid than 100 per minute. Tachycardia is not usually due to heart disease but may result from such causes as hyperthyroidism or tuberculosis. Tachycardia among applicants as a rule is of neurogenic origin and the heart rate will ordinarily slow to a normal rate if the subject rests in the recumbent position for a few minutes and is made to feel more at ease. Bradycardias are likewise rarely due to organic heart disease and heart

rates between 50 and 60 are observed fairly commonly. It is well-known that the heart rate tends to be slow in trained athletes, and rates as slow as 40 per minute may occur normally and should not arbitrarily be considered as cause for rejection. Simple sinus bradycardia is readily differentiated from heart block by noting whether the heart accelerates in a normal manner following vigorous exercise.



4. ELECTROCARDIOGRAPHIC ABNORMALITIES IN NAVAL APPLICANTS. IN THESE CASES EXAMINATION WAS OTHERWISE NEGATIVE AND THE ELECTROCARDIOGRAM PROVIDED THE ONLY EVIDENCE OF ORGANIC HEART DISEASE. *a*, BUNDLE BRANCH BLOCK. NOTE INVERSION OF T WAVE IN BEAT FOLLOWING EXTRASYSTOLE IN LEAD 1. *b*, INTRAVENTRICULAR CONDUCTION DISTURBANCE, WIDENED QRS COMPLEX. *c*, SLURRING OF QRS COMPLEXES, Q WAVE IN LEADS 2 AND 3. VENTRICULAR EXTRASYSTOLES ARE PRESENT DESPITE RAPID HEART RATE OF 130 PER MINUTE. *d*, LOW VOLTAGE OF VENTRICULAR COMPLEXES. Q WAVES PRESENT IN LEADS 2 AND 3.

Electrocardiographic study is rarely necessary for the diagnosis of the arrhythmias encountered among applicants, since serious arrhythmias, such as auricular flutter and fibrillation are rarely encountered. Marked sinus arrhythmia and sino-auricular block may occasionally simulate auricular fibrillation, but these unimportant arrhythmias are readily differentiated by their phasic character with relation to respiration and by their disappearance during the tachycardia of exercise, whereas in auricular fibrillation, the irregularity becomes more pronounced after exercise.

Extrasystoles in our opinion should not as a rule be regarded adversely. In a study recently reported (4) there was no objective evidence of heart disease in 58 percent of 1,142 cases of insurance applicants who were given a complete cardiac examination, including electrocardiography and roentgen study, because of the finding of extrasystoles. Several factors were found to increase the significance

of extrasystoles as a presumptive sign of organic heart disease; among these are:

1. The occurrence of premature beats of multifocal origin.
2. Frequent and persistent premature beats on repeated examinations, particularly if they occur successively in short runs superseding the regular rhythm.
3. A definite increase in the number, or a shower of extrasystoles, immediately after exercise.
4. Occurrence of premature contractions in the presence of a rapid heart rate (fig. 4).
5. Inversion of the T wave in the electrocardiogram in the regular beat which follows the extrasystole (fig. 4).
6. Post-extrasystolic pulsus alternans.

Occasionally extrasystoles can be traced to such causes as smoking and they may disappear following a short period of abstinence from tobacco. If they persist and there is any suspicion of heart disease, electrocardiographic study is advisable.

THE BLOOD PRESSURE

It is becoming increasingly recognized that hypotension is of no significance, and, in fact, life expectancy is decidedly better than average among subjects with low blood pressure. It has been popularly believed that subjects with low blood pressure lack stamina but there is no evidence to support this belief. In general, low blood pressure is not to be regarded adversely either as concerns capacity for physical performance or longevity (5).

Hypertension calls for more careful consideration than hypotension. The diastolic pressure is a truer measure of peripheral resistance than the systolic level, which is influenced to a greater degree by the heart output and which is, therefore, extremely variable. A diastolic pressure which at any time exceeds 100 may be considered to be definitely indicative of hypertension. Even if the arterial pressure subsequently falls to normal, this does not diminish the significance of the high reading, since it has been found that the great majority of subjects even with advanced hypertension at some times exhibit a normal blood pressure (6).

Essential hypertension is not at all rare among applicants even in the younger age groups. In clinical practice most subjects with hypertension are observed later in life when symptoms have resulted from long-standing elevation of the blood pressure. Hypertension frequently begins in the third or fourth decade and an individual may be unaware of the presence of hypertension for many years, at times even though advanced changes have occurred. Such a case is illustrated in figure 2. Hypertension which begins at an early age is more apt to run a severe course than hypertension which does not start until middle age.

Even lesser degrees of elevation of the blood pressure where the diastolic level at any time exceeds 90 mm., and the systolic exceeds 140 mm., should be considered with some care. Several studies have indicated that among young subjects whose blood pressures are found elevated, there is a high incidence of hypertension in later life (7) (8) (9) (10). Various pressor tests (11) (12) have been devised to measure potential hypertension although very recently their significance has been questioned (13). In effect, the initial reading of the blood pressure is a psychic pressor test and has been recognized as having the same significance.

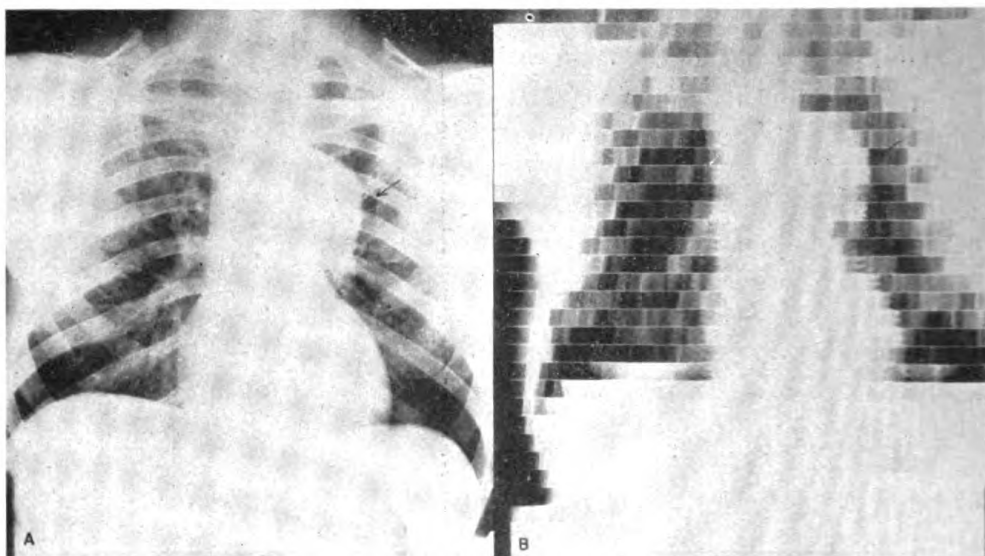
For the purpose of selection for military service, potential hypertension probably should be disregarded, unless as mentioned, the diastolic level exceeds 100, or the pressure on repeated readings never falls below 140 systolic and 90 diastolic. Even though hypertension is apt to develop in subjects whose blood pressure exceeds normal limits at any time, this potential hypertension is unlikely to compromise a subject's physical well-being for many years. It seems questionable whether military life will aggravate the tendency to high blood pressure to a greater degree than civil life.

FURTHER DIAGNOSTIC PROCEDURES

Roentgen examination.—The value of roentgen study either by fluoroscopy or with teleroentgenography has already been indicated, particularly with reference to the diagnosis of cardiac enlargement. It is not practicable or necessary to carry out teleroentgen or fluoroscopic study as a routine procedure although 4- by 5-inch chest films are now being increasingly employed in the examination of applicants. Cardiac measurements may be applied satisfactorily to 4- by 5-inch films using a scale appropriately reduced in size or a scale with lead markings placed directly on the fluoroscopic screen which is reproduced with the chest exposure.

At times roentgen study may disclose an entirely unsuspected lesion, as in the case of the applicant whose roentgenogram is illustrated in figure 5, where physical examination was entirely negative and gave no clue to the existence of an aortic aneurysm.

Electrocardiography.—It has recently been stated that electrocardiography is without value in examination for military service (14). It is true that electrocardiography is less valuable in the types of heart disease which occur in early life than in arteriosclerotic heart disease. However, we have observed many cases among naval applicants where the electrocardiogram provided the only definite evidence of organic heart disease. Coronary artery disease is not a rare occurrence in the fourth decade and our experience has led us to feel that electrocardiographic study should be carried out rou-



5. (A) ANEURYSM OF THE AORTA IN A NAVAL APPLICANT. PHYSICAL EXAMINATION GAVE NO CLUE TO THE EXISTENCE OF THIS LESION (B) THE ROENTGENKYMogram SHOWS EXPANSILE PULSATIOnS OF THE ANEURYSM.

tinely in subjects over 30 years of age whenever heart disease is suspected. Several cases illustrating the value of electrocardiographic study in the selection of applicants are shown in figure 4.

Some caution must be exercised in the interpretation of equivocal electrocardiographic changes, such as moderately low voltage of the QRS complexes or T waves (fig. 6), minor degrees of slurring, etc. It is important, too, to differentiate abnormalities resulting from myocardial disease from those produced by changes in the position of the heart. Thus in obese subjects a deep Q wave may normally be present in lead 3, while in slender subjects there may normally



6. ELECTROCARDIOGRAPHIC ABNORMALITIES DUE TO SMOKING, IN APPLICANT AGED 46. THIS SUBJECT SMOKED TEN CIGARS DAILY AND A PIPE CONTINUOUSLY IN THE EVENING. TRACING A SHOWS FLATTENED T WAVES IN LEAD 1, ORDINARILY INDICATIVE OF MYOCARDIAL DISEASE. TRACING B MADE EIGHT DAYS LATER DURING WHICH TIME HE ABSTAINED FROM SMOKING, SHOW NORMAL T WAVE IN LEAD 1.

be present right axis deviation and inversion of the T waves in leads 2 and 3 associated with depression of the ST segment. This is the typical pattern of right ventricular strain produced by mitral valvular disease and may cause confusion particularly if a systolic murmur is present or the pulmonary artery is prominent, as may occur normally in asthenic individuals as well as in mitral disease. However, the P waves, which are frequently broad and notched in mitral disease, are normal in slender individuals, and the ST and T wave abnormalities disappear in the recumbent position. Unless such electrocardiographic aberrations are correctly interpreted as due to position of the heart rather than heart disease, the electrocardiogram may be misleading and at times do more harm than good.

Characteristic electrocardiographic patterns are observed in rheumatic heart disease, resulting from strain of the various chambers, such as the left auricle and right ventricle in mitral stenosis. Such patterns, however, do not appear early in the course of rheumatic heart disease and are of no practical value in establishing whether mitral valvular disease is present. Roentgen study is more useful as a corroborative diagnostic procedure in rheumatic heart disease than electrocardiography. Electrocardiography is of greater value in the heart diseases of later life, such as coronary artery disease. In hypertension the electrocardiogram provides the most sensitive method for detecting left ventricular hypertrophy (15).

Congenital heart disease is rarely encountered in the examination of applicants and the electrocardiographic changes are variable. A diphasic character of the QRS complexes in the standard leads has been described as a frequent finding in congenital heart disease. In one young applicant with a loud systolic murmur in the second and third left intercostal spaces, this electrocardiographic pattern was a helpful confirmatory sign in establishing a diagnosis of patent interventricular septum.

Heart sound records.—We have made records of the heart sounds in many cases with heart murmurs and unusual heart sounds. Reluctantly we have been compelled to the conclusion that heart sound records are of little practical diagnostic value, although the graphs do provide a means of obtaining a permanent record of auscultatory findings. The instruments do not amplify heart sounds in the same manner as does the human ear. The ear selectively amplifies high frequencies so that murmurs of high frequency are perceived much better than low-frequency murmurs or sounds. Low-frequency sounds, such as the gallop sound in gallop rhythm are often difficult to hear and such sounds are recorded well by instruments. High-pitched murmurs, such as that of aortic insufficiency, are recorded poorly, since the ear amplifies higher frequencies to a much greater degree than the record-

ing machine. In several applicants we have heard distinct aortic diastolic murmurs indicative of aortic insufficiency which we could not reproduce in the stethogram. Sound records permit exact timing of murmurs, such as the presystolic murmur of mitral stenosis, but the experienced examiner as a rule has no great difficulty in timing murmurs so that graphs are rarely necessary. Stethograms are of no value in differentiating functional from organic systolic murmurs.

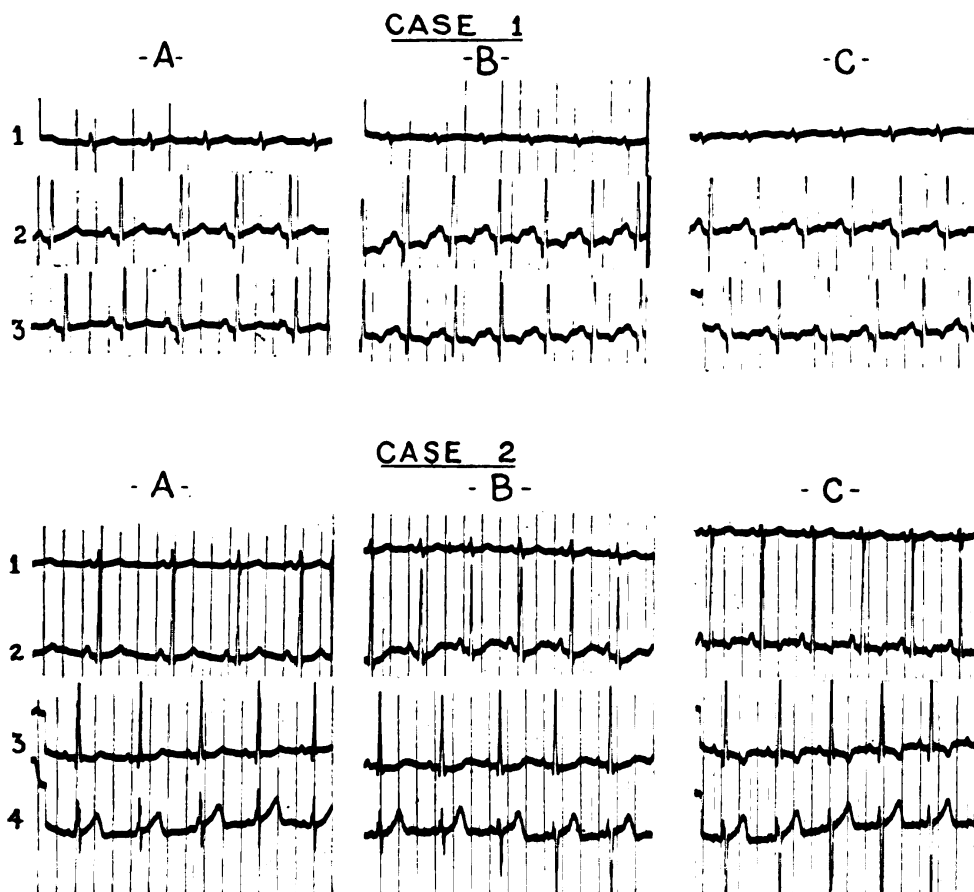
Heart function tests.—Numerous heart function tests have been advocated as an adjuvant in the examination of the heart. The better known of these tests are the Schneider index (16), Frost's cardio-respiratory test (17), flarimeter tests (18), and Master's two-step exercise tolerance test (19). Most of these measure the response of the heart to strain in a standardized fashion. While these tests are of prognostic aid in estimating the functional capacity of patients with heart disease, they are of little or no diagnostic value in determining whether heart disease is present. Heart function tests are usually normal in the earlier stages of heart disease, such as are met with in examining applicants. Even in advanced heart disease the cardiac reserve as judged by such tests is very often normal. Abnormal responses furthermore do not necessarily betoken heart disease, for vasomotor effects as well as the cardiac response are measured. The pulse and blood pressure responses to exercise may be abnormal in normal subjects with labile vasomotor systems. More precisely, these procedures are tests of physical fitness rather than specific tests of heart function.

One test is somewhat more specific as an index of the cardiac response to strain. This is the effect of anoxemia or exercise on the electrocardiogram. This test is a measure of the coronary artery flow reserve and its value is limited to coronary artery disease. Even here, however, extraneous factors may modify the response to the test and some caution in interpretation is necessary. The cases cited in figure 7 illustrate that marked electrocardiographic abnormalities following exercise are not necessarily due to coronary disease but may be caused by the hyperventilation which accompanies exercise. Other nonspecific factors, such as changes in body position, as has already been mentioned, may cause marked electrocardiographic changes.

CONCLUSION

All types of heart disease are encountered in the examination of the naval applicant. The practical value of various signs and diagnostic procedures is discussed and stress is placed on signs which permit the early recognition of organic heart disease, rather than the classic signs associated with advanced stages of various lesions. Illustrative case are cited.

When heart disease is suspected and the findings of physical examination are inconclusive, the teleroentgenogram is valuable in estimating whether the heart is enlarged. A method for conveniently applying measurements of the transverse diameter and frontal cardiac area



7. (CASE 1) FOLLOWING EXERCISE (TRACING B) THE ST SEGMENT IN LEADS 2 AND 3 BECOMES DEPRESSED, T BECOMES FLATTENED IN LEAD 1 AND SHARPLY INVERTED IN LEADS 2 AND 3. NOTE, HOWEVER, THAT IDENTICAL CHANGES OCCUR AFTER DEEP BREATHING WITHOUT ANY EXERCISE (TRACING C).

(CASE 2) FOLLOWING EXERCISE (TRACING B) THE ST SEGMENT BECOMES MARKEDLY DEPRESSED IN LEADS 2 AND 3. NOTE, HOWEVER, THAT EVEN MORE STRIKING ABNORMALITIES RESULT WHEN THE SUBJECT MERELY CHANGES FROM A RECUMBENT TO A SITTING POSITION (TRACING C).

THESE CASES SHOW THAT CAUTION MUST BE EXERCISED IN THE INTERPRETATION OF CHANGES IN THE ELECTROCARDIOGRAM FOLLOWING EXERCISE AS AN EVIDENCE OF CORONARY DISEASE.

in relation to predicted standards is briefly described. Electrocardiography in many cases affords the only definite evidence of heart disease and should be carried out on subjects over 30 years of age when heart disease is suspected. Stethography and heart function tests are of little or no practical value in establishing a diagnosis of heart disease.

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FUNCTIONAL AND SIMULATED DEAFNESS ¹

By F. HARBERT, Commander, Medical Corps, United States Navy

Malingering or simulation embraces all forms of deliberate fraud relating to matters of health (1). As usually defined, malingering

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is the conscious, deliberate, fabrication of symptoms in the reality of which the patient himself does not believe. The unconscious assumption of symptoms in which the patient firmly believes is usually called hysteria or neurosis.

Firestone (23) suggests the term volitional deafness to cover the entire group of simulated, exaggerated, and functional deafness. He defines this as any deafness in which there is interposition of the patient's will in the path of normal reaction to auditory stimuli. This is a useful term because of the similarity of hearing tests in the various groups included in it.

Dufestall divides malingerers according to mentality into normal, degenerate, and hysterical. The normal are characterized by clumsy, unskillful deception, which is irksome to the patient and therefore short-lived. Because they are sensitive to shame they often confess and drop the pretense. The degenerate are characterized by persistency, duplicity, and fertility of resource. They usually have a well-thought-out scheme and are clever in their simulation. The term degenerate has been largely replaced by that of constitutional psychopath. These individuals fully realize what they are doing but deliberately choose the dishonest method of simulation to attain an end because it is a short cut or easy method. The type who simulate are more often of inferior or inadequate personality. Legally they are considered responsible and can adjust to an environment which does not demand too much of them. They are not satisfactory in military service because of their lack of dependability. They usually give a history of inability to hold a job because of lack of tenacity and because of distractability. The latter is characteristic and often helps to distinguish them from the functional group who are too wrapped up in themselves to be distracted. Because of their dislike of sustained effort they readily make excuses and lie easily. Simulation is often an easy extension of this habit.

The malingerer characteristically retains his capacity for play and a good time and stops acting a role when free from observation (2). He may boast to intimates of success in hoodwinking the examiner. In taking the history it often becomes clear that the main reason for consulting the physician is to obtain a certificate of disability or a rating for degree of disability. He emphasizes the effect of his disability on his earning capacity or ability to carry on in an unpleasant environment. The deafness is usually alleged as constant and severe but unilateral because of the difficulty of maintaining prolonged simulation of bilateral deafness. When treatment is suggested he often evades it by an attitude that it is useless, and may produce affidavits of disability from other physicians to prove it. If he agrees to accept treatment he is seldom faithful in carrying it

out. Surgical operation is definitely refused if he believes the examiner is serious in suggesting it and hospitalization is avoided if possible.

The malingerer is usually alert and cooperative at first. If the examination is prolonged, however, he often becomes sulky, uncooperative, and bellicose. Early in the examination he often makes exaggerated attempts to hear by cupping his hand to the ear, leaning toward the examiner, screwing up his face to show his intense listening effort, and sadly shaking his head every time the examiner calls words or numbers. Sometimes the attitude is boisterous bordering on the aggressive, and he often attempts the pal relationship with the examiner or tries to impress him with his uncommon honesty (10).

Inconsistencies are seldom great at first and when they occur tend to become less on repetition. If the examination is protracted, the malingerer usually shows signs of increasing nervousness and strain because he must be constantly on guard and if caught in a gross inconsistency he usually becomes uncooperative to cover his confusion. A favorite method of resisting examination is to admit hearing sounds or forks only momentarily. Foreigners often allege inability to understand what is expected of them when they get into difficulties, although previously they understood readily. The vasomotor changes and nervousness of an unmasked malingerer should not be wrongly diagnosed anxiety neurosis; they are merely signs of anger, shame, or fear when inconsistencies are demonstrated.

HYSTERIA

The broad term functional deafness is here used to cover the psychoneurotic entities commonly called hysteria, anxiety neurosis, and neurasthenia. Janet (4) defines hysteria as the localized lowering of psychological tension in one particular function which disappears from consciousness, i. e., it is "dissociated" from the rest of the conscious personality. The dissociation is usually of a function which has been disturbed or weak, particularly if the function was in activity at the moment of great emotion. For example, hysterical deafness often follows a frightening loud noise as that of an explosion. There is usually a lucid interval between the frightening experience and the onset of symptoms. A slight organic defect such as slight nerve deafness is often demonstrable in the hysterically deaf. This defect serves to focus the patient's attention on his hearing rather than on some other function. Often there is imitation of a relative or associate who has organic deafness.

Patients suffering from hysterical deafness are characteristically composed, calm, and indifferent. The symptom (deafness) while present solves the maladjustment. (The underlying principle of hysteria

is inhibition of a function. For example, deafness, amaurosis, scotomata, and tubular vision are all forms of anesthesia. In simple conversion hysteria there is no hyperacusis or hyperesthesia. These are symptoms of an anxiety state indicating continuing conflict.) A suspension of attention is also characteristic. They hear much better when prodded, when the subject matter is interesting to them, or when they are expecting a communication.

Most authors who have written on hysterical deafness have described patients with definite stigmata in which the transient nature and subsequent course demonstrated the functional nature of the deafness. It is believed however that many cases without other signs of hysteria except deafness probably go unrecognized for years. Gruber (26) states that hysterical deafness is usually unilateral and associated with hyperacusis of the other ear. Politzer (27) adds that bone conduction is markedly decreased or absent and there is diminished sensibility of the affected ear. There may be anesthesia restricted to the external canal or it may extend to a complete hemianesthesia. Amblyopia on the affected side is also seen. Dench (28) describes the deafness as coming on suddenly, frequently after some severe shock, and never varying in its course except for transference from one ear to the other in some cases. Findings are usually consistent, including the inconsistencies which can be repeatedly elicited. Bilateral complete hysterical deafness is frequently transient and usually follows an emotional storm such as a frightening experience. Bone conduction is almost always lost.

Absence of the subjective disorders of tinnitus and vertigo is the rule. When hysterical deafness is associated with mutism no special treatment is required because hearing usually returns spontaneously when speech is restored. Simple explanation that as soon as he speaks the patient will hear his own voice and thereafter hear clearly usually suffices (32). During formal tests the hysteric may temporarily lapse into partial mutism. This is evidenced by a tendency to answer questions by shaking the head or making other signals instead of speaking.

In addition to these well-defined auricular signs of hysteria there is usually a functional disorder of attention. The patient does not try to hear because he is convinced that he cannot, and disregards any conversation or other sound directed toward his alleged deaf ear (30). Hearing shouts at the pinna of the alleged deaf ear may be denied even though they cause reflex wincing and palpebral or pupillary reflexes in unilateral deafness. Obviously the shout is heard in the finger-occluded normal ear but even this is denied because of the tendency to negate sensations that are stronger in the alleged deaf ear. This accounts for the ease with which the Stenger test demonstrates inconsistency in hysteria.

Another psychic phenomenon is dissociation between the perception of pure sound and complex ones such as speech. Thus an individual may admit normal or nearly normal hearing by audiogram but allege total deafness for speech or vice versa. The latter form is rare and usually associated with anxiety. Capacity to hear music may be retained although hearing for speech is denied.

One of the most important characteristics of functional deafness is frequent and rapid changes in auditory acuity (31). Sometimes these changes occur without assignable cause or they may follow treatment. Often a striking improvement in hearing follows the insufflation of menthol vapor in the naso-pharynx because of the sense of liberation produced. Such a rapid and marked improvement obtained by purely suggestive means is a differential from simulation (34). A malingerer may however use such a face-saving out if he realizes he has been unmasked by previous tests. Hysteria may be superimposed on an underlying organic lesion. Accurate testing and the routine employment of inconsistency tests are necessary to recognize that both factors are present in order to avoid a diagnosis of one to the exclusion of the other.

Much improved hearing when free from observation is not necessarily evidence of malingering, because psychoneurotics may be able to hear when composed but not under emotional strain. A confession of simulation or markedly improved hearing under the threat of severe penalties may likewise occur in psychoneurotics. The hysterical deafness may disappear under the influence of strong emotion just as the hysterically paralyzed may run under the stimulus of fear or other strong emotion.

The final and perhaps most important criterion of diagnosis is the cure of hysterical deafness, because a cure by suggestion is quite diagnostic. Electricity as a means of suggestion is sometimes successful and in resistant cases fake operations may be effective. Hypnosis cannot be used in bilateral deafness because the suggestions are not heard. In unilateral deafness, hypnosis is useful mainly as a means of obtaining subconscious revelations of the patient's basic conflicts. Although startling cures may be obtained by strong suggestions while under hypnosis, they are seldom permanent unless followed up by conscious explanation, discussion, and rationalization of the patient's condition. Sometimes a "treatment", such as eustachian catheterization or the caloric test, if reinforced by strong suggestions and assurances by a physician of forceful personality is sufficient but temporary (9) (35). A transient "cure" is sometimes effected by development of a dependency attitude toward the physician.

The most rational form of psychotherapy—explanation with persuasion and reeducation is the preferred method of treatment (32). The

patient is made to understand that the original cause of his deafness has disappeared. At first his deafness was real, he is told, and consequently after a time he ceased to listen. He is informed that listening is an active process like walking and requires conscious effort on his part until it again becomes automatic.

Because of the basic psychic changes, of which deafness is only a symptom, the treatment should really be supervised by a psychiatrist with the otologist cooperating. It is up to the otologist, however, to recognize and diagnose the presence of functional disease and not permit the patient to carry a diagnosis of organic deafness.

NEURASTHENIA

The characteristic finding in neurasthenia is increasing deafness as the examination proceeds. The essential element in neurasthenia is fatigue, with varying degrees of secondary irritability. When this secondary irritability is marked the term anxiety neurosis is usually applied.

Anxiety neurosis may involve the eighth nerve prominently. These cases are agitated, cry readily, usually in self-pity, and are apprehensive and worried about cure. In addition to deafness or hyperacusis they commonly show hyper- or paresthesia of the pinna, mastoid, or scalp. Tinnitus is a common symptom and often the complaint is that the sounds are unbearable or are driving them crazy. It is important to remember that tinnitus is often an early symptom in the development of a psychosis. When a patient exhibits agitation along with tinnitus, it is well to ask for a detailed description of the sounds because sometimes the tinnitus may really be voices or radio waves.

Vertigo is another common symptom. This is seldom of the rotary or vestibular type but is usually described as "swimming" or associated with spots before the eyes. Nystagmus is usually absent. Other symptoms frequently associated are globus hystericus, dry mouth, insomnia, anorexia, weakness, impaired sexual ability, and vague pains and nervousness (51). During examination they often show pathological fatigue, vasomotor instability, tremors, and belching.

The history of onset is usually gradual and progressive but they usually readily admit that the symptoms are quite variable. The variations are often associated with treatment, the weather, and excitement or strain. However, symptoms persist even when not observed. Their story is usually told with a great deal of emotional display and the emphasis is on subjective sensations rather than on inability to carry on, as is the case with malingerers. Their sincerity is shown by the fact that many spend all their means on doctor and hospital bills in efforts at cure.

Because of the patient's preoccupation with subjective sensations, the findings during examination are quite variable and because of pathological fatigue, hearing usually decreases when the examination is prolonged. When inconsistencies are pointed out there is usually no embarrassment but rather bewilderment. The usual reaction is a conviction that the doctor does not understand his case and the patient hurries to another who will explain the symptoms on an organic basis. Should he be convinced of the doctor's ability and findings there is usually an emotional storm, following which he is most amenable to suggestion and explanation.

HYPOCHONDRIA

Persons with or without organic deafness may develop a hypochondriac fixation. These individuals are apparently normal in all respects except for a morbid preoccupation with a single symptom, as deafness. Instead of adjusting to life, they adjust their lives to their deafness. Because others do not show the proper interest and sympathy with their symptom, they are frequently querulous and argumentative. A common avocation is making the rounds of new doctors. When a treatment is suggested they usually have already tried it and take particular pleasure in assuring the doctor that it is no good. Often they blame the neglect or poor treatment of physicians for their present plight, are not amenable to suggestion, and are poor operative risks.

APPARENT INCONSISTENCIES

Since hearing is a subjective sensation, its direct measurement by an observer is impossible. In order to obtain a true approximation of a patient's hearing it is necessary to employ as many objective evidences of hearing as possible and compare them for consistency. An organic lesion should give consistent findings no matter how tested, but there are many factors which sometimes show apparent inconsistency when none really exists. The characteristic of volitional deafness is gross inconsistency of findings which cannot be explained on an organic basis. Comparison of the objective changes in the ear with hearing acuity is impossible because one case may show marked or total deafness with a normal tympanic membrane while another may have nearly normal hearing with a middle ear choked with granulations. Inconsistencies refer only to the functional examination.

Comparison of audiograms made on different audiometers may show considerable variation. Audiometers may be calibrated for either a sound-proof room or the sound level of a particular room. When it is realized that the average masking noise of a living room is 20 decibels, the necessity of noting the conditions under which

any given test was made is apparent (61). Although the deafened patient, especially when suffering from a conductive lesion, is not aware of a moderate rise in the noise level, the examiner is, and he unconsciously raises his voice so that his test words in speech tests sound the same to himself above the general noise level. This actual increase in voice intensity may enable the patient to hear considerably better than during a previous test in a quiet room. This is probably also the explanation of the phenomenon of *paracusis willisiana*.

If the examiner does not raise his voice above a considerable increase of noise level, the increased noise will tend to mask speech or test sounds, thus causing an apparent decrease in hearing (17).

The hearing time for forks may vary considerably because of varying noise levels, varying technic of activation and placement, attention factors, and the presence of tinnitus near the frequency of the fork used in the test (11). Some persons fail to show a definite end point of hearing because of abnormal tone memory.

The Schwabach may also show considerable apparent variation. A purely tactile sensation may be interpreted as sound, especially at high intensity levels and with low forks (18). In performing the Schwabach, it is important to rule out hearing by air particularly when using forks of high frequencies.

The Weber test is notoriously unreliable except in unilateral deafness (15). It may be referred to one ear on light application and the opposite ear on firm application or referred to opposite ears with different frequencies (14).

One of the most difficult things to correlate is sensation and perception. Attempts to compare decibel loss for speech range as shown by audiogram with corresponding values in terms of conversational and whispered voice have not been entirely satisfactory (table 1). One reason for this is that the audiogram is a measure of sensation while the record of conversational voice is a measure of perception and therefore involves not only sensation but also memory, association, and other complex mental functions.

TABLE I¹

Air conduction loss in decibels	Residual hearing for conversation	Air conduction loss in decibels	Residual hearing for conversation	Air conduction loss in decibels	Residual hearing for conversation
10-20.....	20 to 40 feet.	40-50.....	2 to 4 feet.	70-80.....	2 inches to 6 inches
20-30.....	6 to 20 feet.	50-60.....	1 to 2 feet.	80-90.....	1 inch to 2 inches.
30-40.....	4 to 6 feet.	60-70.....	6 inches to 1 foot.	90-100.....	None.

¹ Hayden, A. A.: Hearing aids from otologists' audiograms. *J. A. M. A.* 111: 592-596, Aug. 13, 1938.

Wide variations in hearing different words may be shown by the same individual. This may be due to guessing at words which are imperfectly heard. We do not perceive every syllable of spoken words any more than we perceive every letter when reading a printed page. The sounds suggest the word which fits in the context of the sentence or train of thought. For instance, near the threshold of hearing when numbers are called, the patient may repeat a whole series correctly. If without changing the voice, other words such as names of cities or states are called, the patient frequently continues to repeat numbers sounding similar to the names called. Just a suggestion of the word may suffice for one individual but not for another. The ability to perceive or interpret sensation varies greatly. In evaluating speech inconsistencies, due allowance must be made for language handicaps as in the case of foreigners, slow cerebration, and low intelligence quotient.

In presbycusis or senile nerve deafness there is a loss of hearing for high frequencies only, but loss of hearing for speech, especially the whispered voice, may be considerable in spite of an audiogram showing very little impairment in the speech range (300–3,000). The youngster partially deafened in early childhood adapts much better to speech understanding because his "sound vocabulary" is learned in terms of his impaired sensation. When a sound vocabulary has not developed, as in a child markedly deafened in infancy, and in cases where it has faded as in chronic deafened cases, there may be much better perception of pure tones than conversation (18).

Attention is an important factor because listening is an active process (21). It is possible for the normal individual to negate completely not only the subject matter of a dull lecture, for instance, but even the sound of the speaker's voice. The deafened individual who has been deaf for some time fails to listen unless he realizes he is being spoken to. Once he does so, his hearing is at its best. This is a valuable differential point between organic deafness and malingering. During the formal hearing test the malingerer's hearing is at its worst but he can often be caught off guard and show evidence of much better hearing.

Hearing may be admitted in an ear which is demonstrably totally deaf. This may occur frequently in unilateral deafness, for when the patient occludes his good ear with his finger he can still hear the whispered voice at 1 to 3 feet and conversational voice at 10 to 20 feet. Even greater variation in residual hearing may be noted by changing the amount of pressure applied by the occluding finger. When considerable pressure is applied, a roaring sound which masks hearing is produced. This fact should be remembered in evaluating apparent inconsistencies in unilateral deafness. During a prolonged test, there

may be relaxation of the pressure of the occluding finger in the good ear with consequent improvement in hearing. Whenever there is considerable difference (greater than 25 decibels) in hearing between the two ears, the good ear must be masked in order to obtain a true record of the hearing of the other ear.

Cases of proven total unilateral deafness show a "shadow curve." This curve is almost parallel to that of the good ear but 30 to 60 decibels below it and is due to transmission by air and bone to the good ear while the bad ear is being tested. When the good ear is masked the shadow curve disappears. Honest individuals sometimes allege total deafness in one ear because when testing the ear with a watch or similar faint sound, they fail to hear and conclude that all their hearing is with the good ear. They may actually have a well-marked deafness but still retain some hearing.

INCONSISTENCY TESTS

The only consistent finding in simulated and functional deafness is inconsistency. In fact, this is the criterion of diagnosis and the purpose of malingering tests is to establish inconsistencies. Since the word malingering carries an onus not justifiable when applied to functional deafness, and the tests are equally positive in functional deafness, the term "inconsistency tests" is suggested. The employment of some of these tests does not necessarily imply a suspicion of fraud on the part of the patient. Instead, they should be considered controls which more firmly establish the findings of routine examination. If conducted properly, the patient with organic deafness will not even be aware of the purpose of the tests but is usually impressed by the thoroughness of the examination. A functional element should be suspected in every case of deafness very greatly improved by a simple procedure such as politzerization or in which the degree of deafness fluctuates markedly.

Inconsistencies may be either in the results from the same test or in the comparison of different tests. An example of the former is wide discrepancies in hearing for the same frequency of the audiometer. Great differences between the hearing for speech and the audiogram is an example of the latter. Inconsistency tests may be classified according to the following methods of examination (1):

1. *Misleading*.—This aims at evoking an unconscious or unwitting performance of a function previously denied. In the Stenger test, for example, the patient is hoodwinked as to which ear is being tested.

2. *Distracting attention*.—When testing hearing for forks, a patient may respond to conversational voice questions about the test at much greater distances than previously admitted because his attention is fixed on the forks.

3. *Arousing emotions*.—This aims at arousing the emotions of anger, fear, or shame during the influence of which the patient may perform a function pre-

viously denied. For example, at a distance well beyond that at which hearing for conversation was admitted during formal examination, two examiners may discuss the patient in extremely uncomplimentary terms. Often this method produces visible signs of anger and in some cases the patient may explode and deny the accusations.

Under the fear of severe punishment, either a simulated or functional deafness may disappear temporarily. These methods are not recommended because other effective methods which do not make a personal enemy of the patient are preferable.

4. *Bewilderment or mental confusion.*—(See stethoscope test.)

5. *Periodic observation.*—Audiograms or other tests made on different days usually show wide variation in volitional deafness.

6. *Constant observation.*—Hospitalization or other constant supervision is probably the most effective method of determining the reality of total or very marked bilateral deafness.

7. *Lay observation.*—From the patient's associates it is possible to determine general habits and the presence of marked variations in degree of deafness when free from official observation.

During the examination all third parties except assistants when needed should be excluded. The examiner's attitude should be friendly and gullible and the patient is permitted to tell his story in his own fashion as much as possible. The method of presenting his case, such as a show of excessive emotion, as well as the subject matter of the history should be recorded. Leading questions are to be avoided except to test suggestibility.

Routine tests required in all cases of suspected deafness include the hearing for spoken and whispered voice, Schwabach, Rinne, and Weber. Each test is repeated several times with variations to check for consistency. Simulated and functional deafness can usually be suspected by unaccountable discrepancies among these tests.

The hearing for conversational voice is considered the most important single criterion of hearing and is usually the basis for determining degree of disability for pension purposes or disability ratings. The need for accurate determination of hearing for conversational voice is therefore apparent. In the spoken voice test the examiner starts calling numbers at 40 or more feet with his back to the patient. Without advancing he turns slowly thus giving the patient the impression that he is approaching. If there is no response, the examiner slowly approaches while calling numbers in a monotone with the intensity of conversational voice. Names of states, cities, etc., are interspersed with the numbers and the approach is very slow, thus giving the impression that the examiner is near because of the elapsed time.

Frequently a patient who cupped his hand to his ear, put on a strained expression, and insisted on repetitions at 2 to 3 feet when conversing with him previously, now answers readily at much greater distances. If he fails to do so, the examiner may vary his monotone

somewhat to give the impression of irritation because he obviously should hear at this distance. Care should be taken that the voice is not raised in this procedure. This ruse is more likely to succeed if the examiner's attitude previously has been sympathetic. Often the patient in trying to give a consistent picture will answer. Once a response is obtained further advance is slow until repetition is 90 per cent correct.

It is often found that the volitionally deaf require several repetitions before responding and there is a tendency not to repeat consecutive numbers even when the second number is louder than the first. Often there is a periodicity, every second, third, or fourth number being repeated. When this occurs, the examiner can often obtain a response by stepping back and saying the number due to be repeated at a much greater distance than that for which hearing was previously admitted.

The sudden interjection of a double number as 24 in which 20 is said in a conversational voice and 4 is spoken very loudly often surprises the patient into a repetition of both. This cannot be frequently repeated because it depends largely on the factor of surprise. It is especially useful when the examinee repeats only half of a double number. A conversational request at a greater distance that the examinee repeat both numbers, frequently elicits the response that both numbers were not heard, thus showing hearing for the greater distance. The presence of an attollens reflex at a much greater distance than the distance for which hearing for speech is admitted is suggestive of volitional deafness. If the examination is prolonged and the loudness of the numbers is rapidly and constantly varied, as when two or more examiners at different distances call numbers or ask questions, the malingerer shows increasing signs of nervousness. He is hearing all of the words, knows he is suspected, and must constantly be on guard. The more prolonged and varied the examination, the more hearing does the malingerer admit because of slips. The truly deafened person does not hear anything outside of his admitted range of hearing and is relaxed or at most bored during the examination. The functionally deaf find this procedure wearisome; attention wanders and they often show signs of pathological fatigue. As the examination proceeds, the hearing usually becomes less.

A ruse that frequently works is to tell the patient in a conversational voice at 20 to 40 feet to raise his hand as soon as he hears the examiner's voice and to repeat the numbers called as soon as he hears them. Then starting at 40 feet numbers are called while approaching slowly. Often the hand is not raised until the examiner is close and long before any numbers are repeated. Another ruse is to

have an assistant slowly but audibly approach the examinee from a short distance while the examiner approaches from a greater distance (24). The assistant should shuffle his feet slightly, bump into intervening chairs, or even place his hand on the patient's shoulder and exhale against the pinna synchronously with the examiner's test words. This test is useful in cases where the patient waits until he knows the examiner is close to him before answering.

A long hesitation before answering is very suspicious of volitional deafness. Sometimes if the examiner simply waits instead of repeating the number a response is obtained, or after a long pause the patient may answer that he didn't hear it when he is asked in a conversational voice what the last number was. A sudden command in conversational voice such as, "Open your eyes and turn around," may be obeyed or may elicit an involuntary partial response. Sometimes after a long barrage of words which fail to elicit a response but succeed in producing a highly nervous state, the patient may sigh, relax, and take his finger out of his ear with every sign of relief when the examiner steps back much farther and says quietly "All right, that is all."

The patient may be engaged in conversation within the admitted range of hearing and, while asking a question or giving instructions in a conversational voice, the examiner walks away a distance well beyond the admitted range of hearing on some pretext such as opening a window. If a response is obtained the inference is that hearing for the greatest distance is demonstrated. It is important that the question or instruction be so framed that it is impossible to guess the context after hearing the first part of the sentence.

Patients are instructed to keep the eyes closed during these tests. Blindfolding has seldom been found necessary but, when required by failure of cooperation or for special purposes, a Rings mask is very convenient and effective.

Often a malingerer alleges ability to lip read, especially if he has been caught in an apparent inconsistency. In order to demonstrate his skill, the patient is asked to lip read the examiner who talks in a conversational voice, and the maximum distance at which he is able to do so is noted. The test is then repeated, but this time the examiner speaks without voice, i. e., he exhales completely and speaks without making a sound. The true lip reader can read this with equal facility. The simulator is unable to do so and finds that he has not only shown his inconsistency, but has given the examiner a measure of the distance at which he can hear.

Lip reading can also be eliminated by taking the patient into a dark room on the pretext of transillumination and engaging him in conversation with the lights variously off and on, or by rubbing the tip of the nose so the hand covers the mouth while speaking (25).

It is impossible so to occlude a normal ear with the finger or a plug that hearing for conversational voice is completely abolished. If a patient with unilateral deafness denies hearing all conversation and even shouts near the pinna of his bad ear when his normal ear is occluded, he thereby convicts himself of volitional deafness. A test for insincerity is to have an assistant press deeply in front of the tragus of the good ear but without obstructing the canal while another examiner calls numbers at various distances. Patients with volitional deafness deny hearing though it is apparent that they can hear with the good ear even though it is away from the examiner (34).

(To be concluded)

PSYCHOMETRIC PROCEDURES IN THE DETECTION OF THE NEUROPSYCHIATRICALY UNFIT¹

By W. A. HUNT, Lieutenant, H-V(S), United States Naval Reserve; C. L. WITSON, Lieutenant Commander, Medical Corps, United States Naval Reserve; H. I. HARRIS, Lieutenant Commander, Medical Corps, United States Naval Reserve; P. SOLOMON, Lieutenant, Medical Corps, United States Naval Reserve; and M. M. JACKSON, Lieutenant, junior grade, H-V(S), United States Naval Reserve.

A previous article in the *BULLETIN* has described the neuropsychiatric examination of recruits at the United States Naval Training Station, Newport, R. I. (1). This examination consists of a 3-minute interview with a psychiatrist and is an integral part of the medical reexamination given every recruit upon his arrival at the station. If this interview reveals any inadequacy in the recruit's intelligence, he is referred immediately to the psychologist for intelligence testing. In addition, recruits are sometimes referred for testing when an organic or functional psychopathy is suspected, but cannot be diagnosed clearly in the psychiatric interview. The psychometric picture in such cases often offers valuable material for further establishing a diagnosis.

The objective psychometric procedures of the psychologist are essential. The clinical estimation of intelligence by the psychiatrist cannot equal the more exact determination offered by psychological tests. The clinical judgment of the psychiatrist can serve only as a rough screening process for selecting those cases of doubtful intelligence that demand further study with objective tests. This is demonstrated continually in our experience at Newport. That psychiatric judgments of intelligence may err even when used merely as

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a preliminary sorting process is shown by the fact that in every 1,000 recruits seen by the psychiatrist during the recruit reexamination, 1 or 2 cases of definite feeble-mindedness are overlooked and are not referred to the psychologist at that time. These men are sent to the neuropsychiatric service at some later date during their training period, notably by the Selection Department because of low scores obtained on their selection tests.

Since the psychometric examination is an integral part of the regular medical reexamination, it must be adapted to the conditions of this examination in order that the normal flow of recruits through the receiving unit shall not be interrupted. This necessitates certain special requirements for any intelligence test that is used. The first of these requirements is brevity. Time is at a premium. The number of men tested psychologically in a day at Newport varies from 5 to 20 percent of the total number of incoming recruits for that day. This means that the test battery cannot consist of many subtests, nor can each subtest contain too many items. In addition, the test must be simple to administer and easy to score, and must yield us as much information as possible about the recruit. It should tell us as much as possible about his intelligence, education, and cultural background, as well as the possible presence of mental deterioration and pathological thought processes. Finally, the test should be as fool-proof as possible. Since speed is such a large factor in recruit reexamination, possible sources of error in administering, interpreting, and scoring the test must be minimized. The subject being tested is usually under tension, with excitement and fatigue as definite factors, and possible errors of understanding and interpretation on his part should be eliminated.

It is immediately obvious that the current individual tests of intelligence are much too time-consuming. The authors, with the assistance of Grace Kent of the Danvers, Mass., State Hospital, have evolved a battery of brief tests that can be given and scored in 10 minutes or less and that offer both an objective score and a chance to observe directly the subject's behavior in a series of diagnostic situations. While the authors bear the responsibility for the selection of the particular tests used in the present battery, the tests themselves are the work of Kent, and represent the careful study of many years. The battery consists of four tests. The first of them, arithmetical reasoning, is a simple arithmetic test consisting of 10 problems graduated in difficulty. It is a written test and is given with a 2-minute time limit. Since the subject is usually under some tension when he is referred to the psychologist, it is felt that arithmetical reasoning, a test where he works on paper by himself in a familiar situation, serves as a relatively easy introduction to the test situation. This

is followed by another paper-and-pencil test, Easy Directions, also limited to 2 minutes. Easy directions consists of a series of simple tasks to be carried out on the test paper itself. Both of these tests, since they involve reading, serve as a check for literacy. The third test, verbal opposites, is a purely verbal test in which the examiner speaks a word and the subject is required to respond with the word opposite to it in meaning. While this test is perhaps the poorest one in the battery as a measure of intelligence, it works surprisingly well and has been of particular value in helping to detect psychotic or organic cases, since these subjects oftentimes seize this opportunity for free association, or else show themselves completely unable to grasp the abstract concept of oppositeness. The final test, also a verbal one, is a shortened form of the well-known Kent emergency test, in which the subject answers a series of simple questions involving both information and reasoning.

Arithmetical reasoning and the revised emergency test may be found in Kent's previous publications (2) (3) with complete instructions for administration and preliminary norms. We might say that while Kent regards such norms as she has published as being very tentative in nature, they have needed little revision to serve for our group. The other two tests, easy directions and verbal opposites, are not available for public distribution, as Kent has since published revised forms of them (3), and wishes to avoid any confusion between the old and new forms. Since the new forms contain much of the material present in the older ones we are using, there is no reason to believe that they could not be substituted in a battery such as ours.

The comparison of our test with other measures of intelligence is a difficult one, since an adequate statistical correlation between two measures demands a wide, normal sampling of the ability being measured. The exigencies of time and numbers have made it impossible for us to test a wide range of ability. We only have time to test those recruits of borderline intelligence who are suspected of being feeble-minded. This results in most of our data being obtained from subjects with mental ages from 10 to 12, a sampling which is not sufficiently wide for accurate statistical studies of correlation. Moreover, the group tested has an unduly high proportion of neuropsychiatric casualties. Taking this into account, the Newport battery has agreed very well with the other measures of intelligence in use at the station. It has passed the very practical test of clinical application in some 6,000 cases to the complete satisfaction of the psychiatric staff.

It should be stressed at this point that there is nothing unique about the Newport battery. Other brief batteries presumably as good could be put together by anyone faced with the same problems. The sig-

nificant thing is that brief tests of intelligence can be put together and can serve in recruit selection as adequate substitutes for the longer tests of conventional usage. In fact, the wisest procedure for anyone interested in such brief technics would be to evolve his own special battery fitted to the demands of his particular situation. The literature contains many sources from which material can be drawn. In addition to the material in the references to Kent's work, much can be found in the valuable new *Mental Examiners' Handbook* by Wells and Ruesch (4). A possible source is the Kuhlmann-Anderson test, which consists of a number of separate brief subtests of a paper-and-pencil nature, each part of which is independently standardized and may be purchased in pad form as a separate item without the necessity of buying the entire test (5). It is well to keep in mind that for such purposes older, well established, carefully standardized tests are better than new and novel types which have not been adequately tried out. The most important thing for evolving such batteries is that each subtest selected should have been independently standardized so that it will yield a score which can be evaluated apart from the total score on the entire battery.

Before discussing the numerical measures obtained, we would like to point out that any intelligence test is in essence merely a means of evoking diagnostic behavior in a clinical situation. In this it resembles a percussion hammer used to elicit the patellar reflex or a light used to elicit pupillary responses. The intelligence test gives the subject a chance to react with intelligent behavior. The judgment of intelligent or not intelligent is then rendered depending upon whether or not intelligent behavior has been forthcoming, just as a judgment of disorder of the nervous system may be dependent upon the appearance of the patellar reflex after percussion or the pupillary reflex after illumination.

Psychological tests offer the added advantage that the behavior may be qualified and translated into a numerical measure, or score. These scores may then be treated statistically. Too often, however, this becomes a disadvantage, since so much attention is paid to the numerical measure (score, mental age, intelligence quotient, etc.) that the original behavior of the individual, with all its richness and opportunity for diagnostic interpretation, is completely neglected. Such a situation occurs particularly with group paper-and-pencil tests where the examiner is presented merely with a final numerical measure and is deprived of the chance of witnessing the actual behavior represented by the score. The individual test, such as our present battery, supplements its numerical scores with the opportunity of observing and passing clinical judgment upon the individual's raw behavior in solving the tasks set before him. Moreover, when this clinical judgment dis-

agrees with the numerical score, the path of wisdom lies not in blindly accepting the infallibility of one or the other, but in attempting a reconciliation of the two. Such an attempt at reconciliation has resolved some of our most difficult case problems.

While our test is intended primarily as a clinical instrument, it does yield the usual numerical scores which can be translated into mental ages. In practice each one of the four subtests is scored separately and the score translated into a mental age rating. A record of the four separate mental ages is kept; although, if a single measure is desired, the median of the four may be taken and this may be used to represent the subject's development. We believe, however, that while convenience often dictates the use of a single measure, a clearer picture of the individual is obtained by using all four scores. In fact, the clearest picture of all would be obtained by the complete listing of all the individual responses. The more one abstracts and condenses by the use of numerical symbols, the more one oversimplifies and even distorts the original picture. This is one reason why we have kept this battery as brief as it is. Not only does its brevity meet our necessity for speed, but it results in a total picture sufficiently simple so that the examiner may keep it in mind in its entirety in passing judgment upon the subject's intelligence.

In using any set of norms the wise examiner will remember that norms are no more representative and typical than the group for which they were established. The conscientious clinician will adjust his interpretative norms (as well as his test procedures) to the group with which he is working. This is particularly true of the examination of naval recruits. With the development of the national emergency and the final onset of war the general character of the recruits has undergone changes. Such factors as average age, cultural background, and educational training have shown marked shifts in their nature, and these shifts are reflected in test performance. Thus we have found a tendency for scores on the arithmetical reasoning test to increase relative to other abilities in men of borderline intelligence over 25 years of age. This probably means that survival in an adult world demands a better handling of simple arithmetic by people of dull intelligence than was demanded of them during their adolescence. There are also distinct differences in regional performances. We have found that recruits from the southeastern region will run higher on verbal opposites, indicating a tendency to a vocabulary performance somewhat superior to their other abilities. Moreover, with the increasing incidence of recruits of normal intelligence who are educationally handicapped through the lack of schooling, it is necessary to discount somewhat performance on the two written tests, and to place more stress upon the purely verbal tests. Rather than

evolving a special set of norms for each of such special groups, it has seemed best to us to use one standard set of norms and to temper our interpretation of the subject's performance in the light of a careful consideration of all the environmental factors involved.

A criticism of the Newport battery may be the fact that it is completely verbal and does not contain any performance items. This is not as serious as would first appear, however, as our experience has shown us that performance tests are not as valid for our purposes as are verbal measures. This is due, no doubt, to the "verbal" nature of the naval service. The United States Navy runs the world's greatest trade school. Not only is the enlisted man given opportunities for educational advancement, but he is expected to avail himself of them. Even simple promotion in the ranks demands the reading of service manuals and the passing of tests based upon them. The result is a relatively stronger stress upon verbal factors and literacy than might be true of some other services.

At this point a discussion of our use of the word "intelligence" is in order. We are not interested in the academic "intelligence" of the theoretical psychologist. Intelligence as it is used today may include a general factor (Spearman's *G*), broad group factors (verbal ability, number ability, etc., in the Thurstone manner), and numerous specific abilities. For us the term intelligence (we might better say "Navy intelligence") includes all these in a functioning unity. It means the ability to meet the intellectual requirements of naval service and the ability to benefit from naval training. Our test must measure this ability, and the ultimate proof of its validity comes from its success in picking men who can complete their training period with an adequate record of accomplishment.

The analysis and further clarification of the concept of intelligence is an important and vital matter, but it is of secondary interest in military selection. Whatever "pure" intelligence ultimately may turn out to be, our problem will still be one of selecting good material for the Navy. It is this selection that our test is designed for. It is this "Navy intelligence" that we are attempting to measure, and to which we refer when we call the Newport battery an intelligence test.

Like all intelligence tests our battery under careful analysis also will yield information about possible organic and psychotic disorders which manifest themselves in the subject's intellectuation as shown by his test performance. These pathological signs are found largely in the scatter in test scores. "Scatter" refers to a difference or variation in performance on the various parts of a test. This may be "internal" or found within one of the subtests, i. e., a man may fail some easy items but pass the more difficult ones; or it may be found between the different subtests of the battery, i. e., a man might per-

form well on arithmetic and easy directions but do poorly on verbal opposites.

The diagnostic importance of scatter, however, depends upon an interpretation of all the factors involved, and no specific, absolute patterns of scatter can be set up arbitrarily for diagnostic purposes. Thus, intellectual deterioration often results in relatively higher scores in arithmetical reasoning and verbal opposites and lower scores in easy directions; but this same pattern also may be found in partial illiteracy and this possibility must be eliminated before deterioration is suspected. A higher easy directions score and a low verbal opposites score may indicate an early schizophrenic who is using the opposites test as a chance for word associations of a bizarre and unusual sort; or it may indicate an individual with normal intelligence and a poor cultural background. This is why we believe it is dangerous to suggest specific scatter patterns as invariable diagnostic criteria. We must consider each individual scatter pattern not only in the light of those general principles governing psychotic performance on intelligence tests, but also in the light of our full information concerning the specific and peculiar personality, environment, and history of the individual concerned.

The brief battery we have presented above is not intended as an intelligence test for general usage. It is designed for the military selection of neuropsychiatrically fit recruits and is intended to differentiate the feeble-minded from the normal as quickly as possible. It is not designed to differentiate accurately between great numbers of normal subjects. It should be used as a clinical instrument by persons with clinical experience. In comparison with the other intelligence tests of wider applicability, it shows the following disadvantages:

1. Its range is narrow. It works best at the borderline levels from 8 to 12.
2. It is very brief. This causes some lowering of its reliability and makes it impossible to get fine discrimination between subjects at any one age level.
3. It is heavily weighted with language factors, as there are no performance items included.

These apparent disadvantages, however, are all a function of its special use in military selection. As a rapid means of differentiating feeble-minded and normal subjects for the purpose of selecting those who will profit from training in a situation highly weighted with verbal factors, it has proved successful.

The results of this brief examination determine whether the recruit is sent on duty or referred to the observation ward for further study and eventual rejection because of mental deficiency. We must stress the fact that no recruit is separated from the service on the basis of this one test. Once he is sent to the observation ward he is retested with longer, full-scale intelligence tests, as well as any further special

tests (performance, reading, scholastic aptitude) that may be indicated. He also receives routine examination by the Selection Department, where he is given a series of paper-and-pencil group examinations for intelligence, mechanical aptitude, arithmetic, spelling, and English. Separation from the naval service comes only after a careful evaluation of the results of all this material plus a consideration of the recruit's personality and temperamental make-up.

Each suspected feeble-minded patient is given an individual test on the ward. For this the Wechsler-Bellevue intelligence test (6) is used. This has been adopted as the standard test for such use in the Navy. It is well adapted for the work because it has been standardized on an adult group. Moreover, each subtest in it has been standardized individually, so that it is not necessary to give the test as a whole in order to obtain a mental age rating. It is possible, owing to this standardization of each separate section, to arrange various combinations of subtests if it is not desired to use the test as a whole. At Newport we seldom use digit symbol, picture arrangement, or object assembly tests because of the difficulty of arranging the elaborate paraphernalia for these three items and because of the relative complexity of the scoring system for these three. Where it is desired to use an abbreviated Wechsler-Bellevue for a quick judgment of intelligence, we have found a battery composed of three of the verbal subtests (information, similarities, and comprehension) to be fairly satisfactory. In general, however, each subject is given the complete battery minus those items mentioned above.

It is also necessary to have available on the ward some other paper-and-pencil test resembling the general classification test in order to check on cases where, for reasons of suspected cheating, etc., the validity of the general classification test score furnished by the Selection Department is in doubt. For this purpose we recommend the Otis self-administering test, intermediate form (7) as it is a spiral omnibus test which closely resembles the general classification test and has been compared with it in previous studies.

Two special problems arise which demand special treatment. One is the problem of language handicap. The separation of the Wechsler-Bellevue test into verbal and performance items makes possible a preliminary estimate of the amount of such handicap, but we find the Porteus maze test (8) and the Revised Army beta (9) great help for further checking. The other problem is one of educational handicap. For this it is desirable to have available some simple reading test. At Newport we use one concocted from typical naval safety precautions. This offers the opportunity of checking a man's reading ability on material of the type he will encounter in actual service. Such material is not standardized at present, but is used on an im-

pressionistic basis. It is also handy to have some test such as the Stanford achievement test (10) or the Otis classification test (11) which will give a measure of the individual's grade school accomplishment.

Various so-called personality tests are also used on occasion, but have not proved themselves of any great value. The clinical judgment of the psychiatrist, made on the basis of available material, usually is quicker and more reliable than the results of these tests. For a person without any clinical training and no information about the subject being tested, it can be granted that the various neurotic inventories, etc., might be very helpful. For the trained clinician interviewing the patient individually, although he may have only a minimum of extraneous information, personality tests in their present embryonic stage of development offer little to compensate for the time and energy involved in administering them.

The one exception we would make is in the case of the Rorschach ink blots (12), which have been of definite assistance. At Newport we do not have time for a detailed scoring analysis, and we use the test on a rapid impressionistic basis. It has been of particular value in the diagnosis of borderline schizophrenias. In some other disorders where it is of positive value it still remains an unnecessarily roundabout way of reaching a diagnosis. This is true with organic cases, where we have found that by the time the question of giving a Rorschach test might arise, a diagnosis has already been established on the basis of the routine neurological examination plus a routine psychometric examination. With the doubtful schizophrenic case, however, the Rorschach frequently offers an insight into the individual's thought processes that may be decisive in diagnosis.

In conclusion, we may say that intimate cooperation between psychiatrist and psychologist is essential. They must work together as a team. When they do this, the objective technics of the psychologist are an invaluable complement to the clinical approach of the psychiatrist. Clinical judgment, however, at the present stage of test development, must remain the final court of appeal. While psychology has developed many tests to assist the psychiatrist in his work, it has yet to develop one that can supplant him.

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THE INAPT NAVAL RECRUIT ¹

By MARK GERSTLE, JR., Lieutenant Commander, Medical Corps, United States Naval Reserve; ROBERT LOWELL WAGNER, Lieutenant, Medical Corps, United States Naval Reserve; and TOWNSEND LODGE, Lieutenant, H-V(S), United States Naval Reserve.

The inception of what was destined to become the psychiatric unit at the Naval Training Station in San Diego occurred in October 1940 when a neuropsychiatrist was assigned to active duty. For some months thereafter the psychiatrist was occupied with medical matters of general nature, in the course of which opportunities were afforded to formulate a tentative plan for the psychiatric appraisal of the incoming recruit. After several months he was joined by a second neuropsychiatrist, and shortly thereafter by a psychologist. With the acquiescence of the senior medical officer and guided by the first (January 2, 1941) of several precepts from the Bureau of Medicine and Surgery, the unit began the psychiatric evaluation of all incoming recruits. At that time, in fact until after the attack on Pearl Harbor, the relatively small daily number of incoming recruits permitted the members of the unit to interview each man individually. At first no effort was made to segregate the men who appeared to the psychiatrist to be of dubious value to the service, but only those whose behavior frankly pointed to unfitness were removed from the receiving line and placed in an observation ward pending final disposition. Soon however a provisional company was formed for this purpose. Into this company were placed the "suspects," under the command of an observant and understanding chief petty officer. After a week in this company each man was again interviewed by the psychiatrist, who, at this second meeting with the recruit, had the benefit of additional

¹ Received for publication August 18, 1942.

data contributed during the interim by the psychologist and the company commander. The chief petty officer's opinion of the man's performance in his drills as well as his general success at adapting himself to his new life in the Navy was considered a very important factor in making a decision. If found unfit for retention in the Navy the man was at once recommended to the Aptitude Board for discharge.

Some months ago by order of the Bureaus of Medicine and Surgery and of Naval Personnel, the provisional company was abandoned. However, long before this precept was received, it was the opinion of the senior medical officer in which the members of the unit concurred, that an inescapable stigma was attached to the provisional company. Moreover, it proved difficult for the company commander, despite his sincerest effort to avoid doing so, to judge his men without prejudice. For these and other reasons we welcomed the opportunity to distribute the psychiatric suspects throughout the regular companies so that they might have the benefit of exactly the same environment, discipline, and training as their nonsuspect shipmates. The company commanders know which of their men are on the psychiatrist's list for further investigation. Each commander is given a list of suspects in his company and is asked to observe them with particular care (Form 1). These chief petty officers have shown wholehearted and intelligent cooperation—without which the efficiency of the unit would have been gravely limited. They are assigned as company commanders because of their broad experience in evaluating the fitness of recruits. Therefore their reports are given great weight by the unit.

FORM 1

[Form used in company commander's report to psychiatric unit]

To Company Commander, Co. No. ----- Date -----
Recruit ----- Rate -----

is being studied by the psychiatric unit of the Medical Department to find out if he is fit for naval service. A full and complete report of this man's behavior during the first week or ten days of training will assist the psychiatrist and the aptitude board in deciding this man's fitness for the naval service.

The following questions are to be answered by "Yes" or "No".

1. Does he like the Navy? -----
2. Is he quickly obedient? -----
3. Does he complain a good deal? -----
4. Is this man fit for sea duty? -----
5. Is he cheerful and industrious? -----
6. Does he keep himself neat and clean? -----
7. Does he have many friends in the company? -----
8. Would you like to have him in your division? -----
9. Does he learn Navy routine as well as most men? -----
10. Does he take part in games and other activities when off duty? -----

Write in the lines below any remarks that you would like to make about this man. Use the other side of this sheet for any additional remarks.

Has this man been to sick call? ----- If so, how many times and what for?

Signed-----

Company Commander

Rate.

This report must be returned to Building No. 93 by-----
at-----

These were the salient steps in the evolution of the psychiatric unit. After the entry of the United States into the war two more psychiatrists and two more psychologists were attached to the unit, bringing its total officer complement to seven.

During the first 6 months of this year, 3.8 percent of the recruits who passed through the receiving line were made suspects and called in for further observation by members of the unit. Of these suspects 33.1 percent were recommended by the aptitude board as being unfit and were referred to the commanding officer for discharge. The proportion of suspects and discharges is nearly doubled if the past 3 months are considered alone, because the augmented staff of the unit has been able to investigate each individual case more thoroughly and to disclose maladjustments that would otherwise have been overlooked.

INTRODUCTION OF GROUP SCREENING TEST

When the rate of enlistments became enormously accelerated, as it did after the Pearl Harbor disaster, it became manifestly impossible to continue to appraise all the recruits by a personal interview technic. It became evident that if there were to be any selection whatever of mentally abnormal individuals, it would have to be upon the basis of a method permitting mass administration as well as a rapid and facile interpretation of the results.

For several months the unit had been making occasional use of a simplified and greatly abridged form of the Thurstone personality schedule. Our modified personal data sheet (hereafter to be referred to as the PDS) while never previously standardized as a whole, is composed of items which have been demonstrated to have validity in differentiating normal persons from those who are maladjusted.²

² The Thurstone schedule is, in turn, one of the many revisions of the Woodworth personal data sheet which inaugurated a great amount of research in questionnaire methods following World War I. The selection of items in the modified PDS was governed by a statistical analysis, " 'Neurotic' Indicators at the Adolescent Level," by Remmers, Whisler, and Duwald, in the Journal of Social Psychology, 1938, vol. 9, pages 17-24. With a few minor changes in wording and arrangement our list is similar to a list prepared by these writers and found to correlate 0.89 with the total score on the 216 items of the Thurstone personality schedule.

FORM 2

PERSONAL DATA SHEET

Do not write
in this space.

Co. No. _____

Date_____

Number_____

Name_____ Age_____

(Last name) (First name) (Middle name)

There are no right or wrong answers. Answer each question by drawing a circle around the "YES," or the "NO," or the "?." Use the question mark only when you are sure that you cannot answer "YES" or "NO." Try to answer every question.

Do you usually feel well rested in the morning?_____ YES NO ?
 Do things ever seem to swim or get misty before your eyes?_ YES NO ?
 Do you feel sad or gloomy a good deal of the time?_____ YES NO ?
 Are your feelings easily hurt?_____ YES NO ?
 Are you ever bothered by a feeling that things are not real?_ YES NO ?

Are there thoughts which keep coming into your mind even
 when you do not want to think of them?_____ YES NO ?
 Do you get discouraged easily?_____ YES NO ?
 Do you often feel miserable?_____ YES NO ?
 Do you change your mind often before doing something?_____ YES NO ?
 Do you often worry over possible misfortunes?_____ YES NO ?

Are you troubled with feelings that you can't do things as
 well as other people?_____ YES NO ?
 Do you make friends easily?_____ YES NO ?
 Does your mind often wander so that you forget what you
 are doing?_____ YES NO ?
 Do you often have bad pains in any part of your body?_____ YES NO ?
 Do you feel tired a good deal of the time?_____ YES NO ?

Are you ever bothered by the feeling that people are reading
 your thoughts?_____ YES NO ?
 Do you think you have more fears than most people?_____ YES NO ?
 Are you shy?_____ YES NO ?
 Do you day-dream a good deal?_____ YES NO ?
 Do you often feel lonely, even when you are with other
 people?_____ YES NO ?

At night are you often troubled by the idea that someone is
 following you?_____ YES NO ?
 Is it easy to make you angry over very small things?_____ YES NO ?
 Do you usually feel excited?_____ YES NO ?
 Do you ever feel that someone is trying to do you harm?_____ YES NO ?
 Do you ever have the feeling that you are not like other people? YES NO ?

REMARKS: Write here anything you would like to say on any of the questions.

FORM 3

DISTRIBUTION OF SCORES ON PERSONAL DATA SHEET

[1,000 unselected recruits]

Number of neurotic answers	Frequency (N=1,000)	Percentage frequency	Cumulative percentage
0.....	273	27.3	27.3
1.....	189	18.9	46.2
2—median score for group.....	152	15.2	61.4
3.....	107	10.7	72.1
4.....	94	9.4	81.5
5.....	56	5.6	87.1
6.....	38	3.8	90.9
7.....	22	2.2	93.1
8.....	23	2.3	95.4
9.....	11	1.1	96.5
10.....	14	1.4	97.9
11.....	5	0.5	98.4
12.....	4	0.4	98.8
13.....	3	0.3	99.1
14.....	4	0.4	99.5
15.....	1	0.1	99.6
16.....	0	0.1	99.6
17.....	2	0.2	99.8
18.....	2	0.2	100.0
Total.....	1,000	100.0	

None of the widely known or adequately standardized neurotic inventories was practicable for use in this situation, primarily because of the time required for scoring. The arrangement of "right" and "wrong" answers on the PDS makes it possible to evaluate the papers as rapidly as the pages can be turned by hand. Moreover, the diction on most standard neurotic inventories is either too difficult on the one hand, being designed for high school and college students, or it is too childish, being designed for children in the primary grades. This characteristic impairs their effectiveness for a widely heterogeneous group such as naval recruits. The PDS is constructed in such a way that these difficulties of scoring time and inappropriate wording are largely avoided.

As used in connection with recruits in the receiving line, preceding the physical examination, the men are seated on the floor of a long examining room in groups of up to 75 at a time. The men are told that the test will occupy a five-minute period in which they will fill out the front page and, in addition, write statements on the unprinted reverse side of the paper, giving such information as: First, whether or not they have been patients in a mental hospital; second, whether or not they wet the bed at night; and third, a list of arrests and the reasons therefor.

The papers are then quickly checked over by the psychiatrist after which he questions "doubtful" individuals while they are still going

through the receiving line. Ordinarily less than 10 minutes is required to check over the papers for a draft of 75 men. Men to be individually interviewed by the psychiatrist are thus screened out on the strength of the following types of anomalous responses:

1. Inability to follow the directions or to complete the simple dictation asked for on the back of the sheet.
2. An erratic spontaneous comment on the paper.
3. Acknowledgement of bed-wetting, mental hospital experience, or an outstanding delinquent record.
4. An outstandingly high neurotic score (usually above 10 unstable responses). The "neurotic" score, in itself, was rarely the primary reason for referral to the suspect list but this was merely one element in a broader response pattern.

As a device for meeting an acute emergency the PDS method is believed justified. It probably provides as thorough a screening out of misfits as any procedure the psychiatric unit with its limited facilities could employ under the pressure of the recruiting rush. On the other hand the technic has limitations. Its only justification under ordinary conditions would be as a supplement to a reasonably comprehensive psychometric examination and individual psychiatric interview. Among the limitations the following should be mentioned:

1. The PDS method does not screen out all of the inapt recruits. Certain psychopaths or even psychotics have no difficulty whatever in making perfectly normal scores on the test; a high score points to poor personal adjustment, but a low one does not necessarily mean good adjustment.
2. If mechanically administered and interpreted this type of test can readily result in injustices to individual recruits. Not all persons with high neurotic scores are necessarily unfit for service. In untrained hands the method would readily become valueless and, particularly in view of its apparent simplicity, would constitute a real danger.

ROLE OF THE PSYCHIATRIST

The PDS is the first means by which all incoming recruits are separated into one of two classifications. As a result of the scoring of these sheets each recruit is either passed to unqualified duty or regarded as a suspect. This decision is made by the psychiatrist stationed at the receiving unit and examining on the receiving line. All the recruits turning in PDS's which are aberrant, are subjected to a very brief personal interview which takes place immediately following the physical examination. This personal interview either confirms or negates the impression given by the PDS. In the former instance he is placed on the suspect list; in the latter instance he is unconditionally assigned to regular duty. About 35 percent of all incoming recruits are interviewed by the psychiatrist in the receiving line. About 4 percent are placed on the suspect list. Occasional individuals are sent directly to an observation ward for immediate study as being obviously unfit for service.

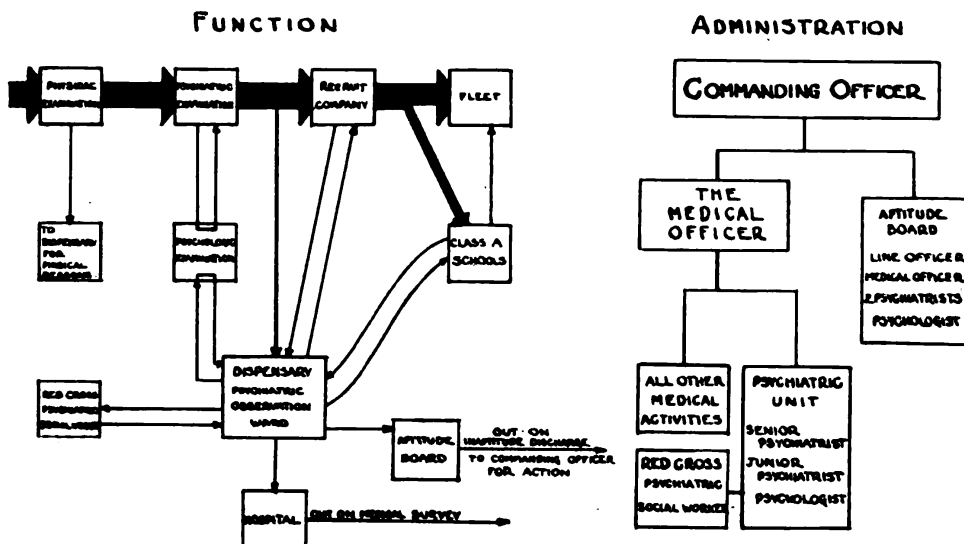
After having been in training for 10 days, each suspect is interviewed by a second psychiatrist. This later interview is longer and more searching. Full use is made of the accumulated data available at this time. These consist of:

1. The written tests and forms which the recruit has filled in since his arrival.
2. A written report from his company commander of the recruit's behavior in company and an opinion of his general fitness. This trial period of training is considered most important especially in the case of a recruit whose relative aptitude or inaptitude is clearly evident only under actual working conditions.
3. The written conclusions of the psychologist studying the case.
4. Social agency reports in the special instances where they have been requested by a member of the unit.

Usually this second psychiatric interview determines whether or not the recruit is returned to unqualified duty (in which case he is dropped from the suspect list and is no longer a concern of the unit), or whether the psychiatrist recommends him to the aptitude board as a candidate for a special order discharge (until recently termed an "inaptitude discharge").³ Occasionally a further trial in his company is recommended pending final decision.

The aptitude board is composed of a line officer of long naval experience, a medical officer of the regular service (nonpsychiatrist), two psychiatrists and one psychologist. (See Form 4 for the structure of this board.) After reviewing the case material, provided the

PROCEDURE FOR ELIMINATION OF RECRUITS UNFIT FOR SERVICE FOR PSYCHIATRIC OR NEUROLOGIC REASONS
AT U.S. NAVAL TRAINING STATIONS



4.—CHART OF FUNCTION AND ADMINISTRATION OF PSYCHIATRIC UNIT AND APTITUDE BOARD.

³ Joint letter from Chief of Naval Personnel and Chief of Bureau of Medicine and Surgery dated June 1, 1942, modifying the Bureau of Navigation-Bureau of Medicine and Surgery letter dated April 3, 1942.

members of the board unanimously concur with the psychiatrists' judgment, the recommendation for discharge with a summary of the reasons therefor, is submitted to the commanding officer for action.

In addition to suspects from the receiving line, men are referred to the unit for study and disposition from several other sources. These include:

1. Men in training not detected on the receiving line, who have by their behavior impressed their officers as apparently unfit.
2. Men who have attracted the attention of medical officers in the dispensaries, because of hypochondriacal, neurological, or psychosomatic symptoms.
3. Men who have finished training and have been assigned to class-A schools with subsequent "maladjustment."
4. Certain disciplinary cases referred by the commanding officer or executive officer with a request for a report of the psychiatric examination.

These men are admitted to an observation ward where psychiatric technicians and corpsmen note their behavior and report to the psychiatrist.

The observation ward is composed of recruits exhibiting conditions which can be better studied in a ward than in a regular training company (such as men giving a history of epilepsy, enuresis, bizarre and peculiar behavior, etc.). The average census of the ward is 40 men who remain an average of 6 days for psychiatric and psychological study. All patients in the observation ward are ambulatory since this ward is unlocked and has no provision for the care of psychotics. The latter are immediately transferred to the naval hospital as are also patients exhibiting marked neurological syndromes.

ROLE OF THE PSYCHOLOGIST

The psychologist is concerned with evaluating the personality of the incoming recruit for purposes of contributing to the psychiatric picture. The unit's objective is to select those men who are unfit for service. This entails inquiry into an individual's social, emotional, and familial adjustments, his temperament and attitudes. The primary value of the psychological interview is the light it sheds on the patient's personality make-up, various character traits, special talents, and defects. The psychologist has a considerable part of the responsibility in identifying the mentally deficient individuals coming through the receiving unit and in establishing an estimate of the level of mental efficiency of all other recruits under observation by the psychiatric unit. A point sometimes not fully recognized is that the unit is as interested in demonstrating that a patient is normal, as in discovering his abnormalities.

In any large cross section of the population, such as recruited by the military services, the distribution of brain power will approximate

the normal probability curve. About 60 percent of such a group will possess intelligence levels reasonably close to average, both above and below. The "superior" and "inferior" individuals will each comprise another 15 percent, while the "very superior" and "very inferior" individuals will make up the balance with perhaps 5 percent in each classification. In civil life the "very superior" constitute the upper-professional and managerial segment of the population; in military life they are capable of becoming officers if endowed with other necessary qualities including leadership.

The "very inferior" are rarely capable of more than fourth grade achievement in school. At best, in civil life they are satisfactory unskilled workers under supervision of their more competent fellows. At their worst they contribute to the ranks of tramps, alcoholics, economic dependents, and criminals. It is this group, i. e., the intellectually and socially incompetent, who are designated as feeble-minded. They constitute 1 percent to 3 percent of the total population. They are a hindrance to the efficient operation of the military, or any other organization, unless segregated and given special oversight at tasks within their own limited capacities. The Navy's present structure is not adapted to such individualized treatment and accordingly such defectives must be rigorously excluded. The recruiting offices have become less discriminating in their selections of recruits than they were before the war. Although idiots and imbeciles are so conspicuously subnormal that they do not get by the recruiting officers, it is not exceptional to find a draft which includes a few morons and borderline defectives. The psychiatric unit has been ordered to reject such men because of the hazard which they constitute under conditions of mechanized warfare. Even though brains are sometimes disparaged as less important than brawn, this is a fallacy. An effective cerebral cortex is as important to the apprentice seaman as any other part of his anatomy. The Manual of the Medical Department (ch. II, sec. XXI, par. 1514) recognizes this when it states:

Every effort must be made to reject the mentally deficient and those showing evidence of serious nervous affections. The importance and value of a thorough and effective examination of the applicant's mental suitability for the service cannot be overestimated. Morons * * * are always a continuous source of weakness and detriment. Such men under no circumstances should be accepted for enlistment.

Mental tests of one kind or another are indispensable aids in mental diagnosis. But "feeble-mindedness" cannot be determined by test scores alone, any more than a diagnosis of measles be made simply because a patient is running a high temperature. "Feeble-mindedness" is a concept relating to ability to get along with others and assume responsibilities. Such a classification can only be made ac-

curately on the basis of knowledge of such additional factors as a patient's schooling, nationality, home background, physical health, past employment, delinquency record and institutional experience. Although intelligence measurement is of some importance in itself, the actual scores earned on various tests used in the interview are only of incidental interest. Of much greater importance is the fact that the standardized test situation provides an excellent opportunity for the examiner to make observations of such things as nervous habits, mannerisms, persistence, self-confidence, anxieties, reactions to failure and success, attitude toward authority, submissiveness and aggressiveness and so on. In short, the purpose of the interview is to obtain as full a clinical picture as possible of the recruit's personality in the time at our disposal.

Recruits who are placed on the suspect list at the time of passing through the receiving line are called in for psychological testing during their first week at the training station. This is preparatory to their final interview by the psychiatrist on the 10th day. The men are assembled in groups and given a brief personal history form to complete. This provides basic identifying data and a core of information regarding family, schooling, marital history, health, employment, and delinquency record. Also given to the group are short written tests of literacy and verbal intelligence. These are scored on the spot and the men sent in for individual interview immediately after the group examination.

The individual interviews range in length from 5 minutes in the case of recruits whose papers and appearance are satisfactory, to perhaps an hour in the occasional situations where detailed observations seem required. The psychological interview usually consists of the following procedure:

The examiner first goes over the recruit's history-sheet with him and inquires particularly into such items as home background, employment, marital and court experiences. The examiner also reviews the atypical responses to the personal data sheet (given several days previously) and inquires into the reasons for them. If the impressions thus gained are negative, insofar as they bear on the recruit's naval fitness, and if his mental age and literacy are substantially above the 10-year norms for the group tests, he is returned to his company to await the final interview with a psychiatrist. Doubtful and inferior individuals are given as much additional testing and interviewing as seems necessary to establish their level of efficiency and psychopathological tendencies. The Healy Pictorial Completion Test II, has proved valuable not only as a nonlanguage measure of "intelligence" but even more so in detecting certain kinds of deteriorated individuals whose absurd responses on this test and bizarre explanations are sometimes the first tangible clue obtained regarding abnormalities in ideational processes.

The tests of which the most frequent use is made are the Kent E-G-Y, the Healy PC II, and parts of the Bellevue-Wechsler, especially the nonverbal scale. Other tests occasionally employed, depending on

the nature of the problem at hand are the Bernreuter personality inventory, the attitude interest analysis (Terman and Miles), the Minnesota rate of manipulation tests, and various psycho-physical measurements such as dynamometer and spirometer. One of the psychologists is an experienced Rorschach examiner and use is made of this method in selected cases.

PROBLEMS OF NAVAL PSYCHIATRY

It is curious, in a way, considering the devastatingly large number of neuropsychiatric casualties accumulated in World War I, that the prophylactic attempt at elimination of inapt recruits did not sooner assume its proper importance.

Unquestionably our entrance into this present global struggle brought to the foreground the necessity for making as thorough an attempt as possible to avoid a repetition of the bitter experiences of 1917 and 1918. It is enough to recall that approximately three-fifths of the disabled veterans of all A. E. F. casualties were neuropsychiatric in nature and that these men have cost our Government well over one billion dollars. It is also significant to recall that most of these break-downs occurred within 1 month after induction into the armed forces.

In a recent publication,⁴ the authors, referring to World War I, quote the following from the Official American History:

Eight thousand, six hundred and forty cases of nervous and mental diseases discovered in the United States were retained in the service, while in the opinion of neuropsychiatrists in the Medical Corps, they should have been separated from it.

These facts point unmistakably to the enormity of the psychiatric problem facing all branches of the armed forces both here and abroad. Upon the thoroughness with which this problem is met depends not only the morale of the fighting units but also that of the civilian population. Important as is the economic factor, it is dwarfed by the necessity for ensuring the utmost efficiency in the personnel upon whom the successful outcome of this war entirely depends.

No description of the development of our psychiatric unit can be attempted without awarding sincere praise to the assistant-psychiatric field director, representing the American Red Cross, and her competent staff. Not only has this agency proved invaluable in the investigation of factual data concerning the home environment of recruits, but by personally interviewing every boy who is discharged from the service, the difficulties and problems attendant upon his return home have been materially lessened. This facility has been

⁴ "Neuroses in War," by several authors under the editorship of Emanuel Miller, M. R. C. P. with a concluding chapter by H. Crichton-Miller, M. D., F. R. C. P. The Macmillan Co., 1940.

made available to the unit by the Red Cross and with the continual expansion of our work we find it more and more useful, acting as it does, as a liaison between the service and the civilian community. Every effort is made to see that once returned home, the discharged recruit is established in the milieu into which he can best be fitted. By so doing we feel that we are performing no less than our duty to the community at large, and we also realize that anything that can be done to prevent the sometimes disappointed lad from losing caste with his family and acquaintances is worth while.

In conclusion let it be clear that none of us clings to any delusion concerning the omniscience of the psychiatrist or psychologist. The particular procedures employed at the training station in San Diego represent an attempt to meet the ever-changing demands as they have arisen. Undoubtedly they leave much to be desired. Nevertheless, modifications and improvements will be forthcoming as our experience increases and the need for the unit's work becomes more generally recognized.



It is apparent that there are wide variations in the blood concentration curves of different patients following the hypodermic administration of each of the sulfonamide solutions studied. Plummer and Wheeler noted this unpredictable variation in the blood concentration of sodium sulfadiazine when repeated doses were given intravenously. Because of the decided variations in the blood concentrations of the sulfonamide compound attained in different patients following the subcutaneous injections of these drugs, one can neither adopt a standard dosage nor give subsequent doses at arbitrarily fixed intervals. If such a routine was followed one patient might receive a toxic dose while another might receive an inadequate one. In order to circumvent these difficulties it is necessary to guide treatment by following the blood concentrations at frequent intervals. By so doing one may determine the pattern of the blood concentration curve for each patient and give subsequent doses at an optimal time; also the dosage may be altered to suit the case in question.

An idea of the pattern of the blood concentration curve may be obtained by determining blood sulfonamide levels between 4 and 8 hours, and again between 14 and 18 hours after treatment has been started. Subsequent treatment may be guided by the use of these two determinations.

In general, it has been found necessary to give the following approximate amounts per thousand cubic centimeters hypodermoclysis to achieve adequate blood concentrations: sulfathiazole 7.5 to 8 gm. (the blood concentrations may be low even with this dosage), sulfapyridine 5 to 7 gm., and sulfadiazine 5 gm. In gen-

eral, the blood concentrations were higher and more prolonged after the use of sulfadiazine subcutaneously than after the use of the other sulfonamide compounds. This difference in the metabolism of sulfadiazine conforms to that noted by others.

It is apparent that the intravenous doses given to several of the patients included here were too small to achieve an immediate high blood concentration. The intravenous doses in the amounts used caused little appreciable difference in the blood concentration curves as compared with those obtained following initial subcutaneous doses. Hence, if one desires to obtain an immediate high blood concentration, a larger intravenous dose must be given than was used in this study.

No attempt has been made in this study to evaluate the therapeutic effect of these drugs when given subcutaneously. However, the impression was gained that this route of administration gives results comparable to those achieved by oral administration.

This paper is not an attempt to promote the subcutaneous mode of administration when the drugs can be given orally. Most patients can and should be treated by the oral mode of administration. However, it is felt that giving the drugs by hypodermic injection is a great convenience, and gives satisfactory results for patients who are unable to take the sulfonamides by mouth for one reason or another—such as an unfavorable mental state, persistent vomiting, and sometimes after an operation.

CONCLUSION

1. The sodium salts of sulfapyridine, sulfathiazole, and sulfadiazine may be conveniently and safely administered subcutaneously when the patient cannot take the drugs orally. The subcutaneous administration of the sodium sulfonamides to 160 patients caused no local reactions.

2. These drugs may be given subcutaneously in concentrations of from 0.4 percent to 0.8 percent in isotonic solution of three chlorides, isotonic solution of sodium chloride or one-sixth molar sodium lactate solution.

3. Decided variations in the blood concentrations of the sodium sulfonamides were encountered when given by hypodermoclysis. These values were not predictable. Treatment must therefore be based on the blood concentrations encountered for each individual patient.

4. Sodium sulfadiazine was the most convenient drug to use hypodermically. A 1,000 cc. hypodermoclysis containing 5 gm. of this drug usually gave satisfactory blood concentrations for about 20 hours.—Taplin, G. V.; Custer, E. A.; and Young, L. E.: The sodium salts of sulfapyridine, sulfathiazole, and sulfadiazine; their clinical use by hypodermoclysis. *J. A. M. A.* 121: 313-315, January 30, 1943.

CLINICAL NOTES

DIVER'S SQUEEZE ¹

REPORT OF TWO CASES

By **ROLAND O. SALA**, Lieutenant Commander, Medical Corps, United States Naval Reserve, and **CHRISTOPHER C. SHAW**, Lieutenant Commander, Medical Corps, United States Naval Reserve.

Two nonfatal cases of mild diver's squeeze occurred during operational diving instruction at the United States Naval Air Station, Pensacola, Fla., on February 5, 1942, and are reported herewith.

CASE REPORTS

Case 1.—**L. H.**, seaman second class, USN, was undergoing a diving qualification test. He was under water at a depth of about 35 feet for 17 minutes. He states that water entered his helmet as air escaped through a loose gasket. During the last 5 minutes of the "dive" his life line became fouled in the anchor chain. He attempted to signal the surface crew but was unable to do so because of slack line. The surface crew reported that he failed to respond twice to signals and so he was then promptly brought to the surface in an unconscious condition. He had, however, regained consciousness on his arrival at the landing where he was first seen by medical personnel.

On arrival at the sickbay, the patient was mentally clear and cooperative; pulse rate 90, blood pressure 130/60. He complained of severe headache and sore throat and was bleeding slightly from the nose, mouth, and ears. There were frequent small hemoptyses of freshly clotted blood. Cyanosis of the scalp, face, neck, and upper thorax was striking. A deep purple discoloration of the skin extended from the scalp downward over the face, neck, shoulders, chest, and back to a ridge of soft tissue representing the line of application of the diving helmet. Myriad petechial hemorrhages were present in the conjunctivae, in the buccal mucosa, soft palate and nasopharynx; also in the skin of the upper chest, back, and shoulders. In addition to the cutaneous petechiae, extensive ecchymoses were present over the scapulae and platysma above the contact-ridge of the diving helmet.

Both middle ears were full of fresh blood; tympanic membranes ruptured. No hemorrhages were present in ocular fundi. The superficial and deep reflexes were not impaired. There was a transient, gross tremor of the upper extremities but no motor paralysis.

The patient complained occasionally of pain in the right anterior chest. There was no evidence of fracture of ribs or crushing injury to thoracic cage. Percussion note not impaired, breath sounds normal, no râles heard on auscultation

¹ Received for publication November 5, 1942.

Abdomen soft and relaxed, no masses palpable. White count 39,800. Urinalysis negative.

He was immediately given oxygen with remarkable improvement in his cyanosis and relief of headache. At the end of 30 minutes the oxygen mask was removed and the cyanosis immediately returned, but not to such a severe degree as formerly. Administration of oxygen was promptly resumed.

Case 2.—W. C. M., seaman second class, USN, was injured in a diving accident about noon on his way down to 36 feet below the surface. There was no fouling of the line but he began to lose consciousness. He signaled the deck crew who brought him to the surface at once. He was met at the dock by the ambulance and was brought immediately to the dispensary. The chief complaint was headache.

On arrival in the ward he presented very deep cyanosis of the head, face, and neck, with extensive subconjunctival hemorrhages. Petechiae were present in skin of shoulders, chest, and back and limited to the area covered by the diving helmet. Epistaxis was present, also blood in the nasopharynx. Both middle ears were filled with hemorrhage but the drums were not perforated. The patient vomited frequently, chiefly blood mixed with mucus. Later hemoptysis of freshly clotted blood appeared. The chest was clear on anterior and posterior examination.

Because of the vomiting and hemoptysis it was difficult to apply an oxygen mask. He was given 50 cc. of 50 percent glucose intravenously. This served to relieve the headache somewhat and to allay the vomiting. Oxygen was then instituted. The pulse rate on admission was 84 and irregular, the blood pressure 150/80. The blood count, taken just before the oxygen was started, was: WBC 22,400, bands 7, segs 65, lymphs 22, baso 1, monos 5; RBC 4,560,000; Hb. 85 percent; urinalysis negative.

After inhalation of oxygen for an hour, the patient became quiet, sleeping and breathing easily. No further vomiting, no restlessness; reflexes normal. When the oxygen mask was removed, the cyanotic color reappeared, but there was no other evidence of respiratory or circulatory embarrassment.

In the hospital these two enlisted men made an uneventful recovery. Photographs taken 10 days following the "accident" show fading petechiae but persistent subconjunctival hemorrhages. Three weeks later the ear drums were found to be normal and hemorrhages in the middle ear had been absorbed. No impairment of hearing. The patients were returned to duty, but not to further diving instruction, at the end of a month.

COMMENT

The effect of a fall under water is known as "squeeze." The fall causes a sudden increase of water pressure proportional to the depth and rapidity of the descent. If there should fail to be a proportional increase of the air pressure in the metal diving helmet to equalize the pressure of water at the depth to which the diver's body has fallen, the excess hydrostatic force (negative pressure differential) on the diver's body will tend to drive the body of the diver into the helmet.

When a negative pressure differential occurs within the suit and helmet, the hydrostatic force begins first to drive the body fluids and then the body tissues into the rigid metal helmet. The greater the

depth, the greater the weight of the column of water above the diver and the greater the pressure of air in the dress and helmet required to neutralize this hydrostatic force. If air is supplied under sufficient pressure, as the diver descends, to compensate for the increasing hydrostatic force at greater depths, the body of the diver remains in "equilibrium" within the suit and helmet. If, however, this pressure equilibrium is disturbed, one of two circumstances will rapidly develop.

If the dress is overinflated (positive pressure differential), the diver will be "blown up" to the surface like a cork with danger of caisson disease, or "bends," from too-rapid ascent from deep depths. There is also the ever-present danger of mechanical injury from striking against the ship's hull or becoming fouled in the anchor chain on being "blown up" from any depth.

If the air pressure in the diving dress falls below the hydrostatic pressure, "squeeze" immediately takes place. The injury from squeeze may cause death that is almost instantaneous. Profuse bleeding from nose, mouth, ears, lungs, and stomach occurs; unconsciousness rapidly supervenes and death intervenes before the diver can be brought to the surface. If the negative pressure differential is great, the hydrostatic force will drive (or squeeze) the man's body into the helmet, stripping from the bones the soft tissues and muscles which lie outside the margin of the helmet, resting on the shoulders, upper thorax, and scapulae. Extreme cases have been known where the diver has been moulded and crushed into his helmet with such terrific force that it was impossible to extricate his remains.

"Squeeze" is usually the result of an accidental fall under water. It may occur from other causes—for example, when a diver descends ahead of his air supply; that is, when he descends before the pressure within the dress and helmet is equal to the external water pressure. It may also be caused by a ruptured air hose or by a leaky safety valve in the helmet. Slight squeeze may develop as the result of a ruptured cuff of the dress while the diver raises his arm in an attempt to reach the escape valve.

In any event, the mechanism is the same. If there is a sudden increase of water pressure, with a failure of corresponding increase in air pressure, the helmet escape valve becomes seated and the air within the diving suit will be forced from it into the noncompressible helmet, with the volume diminishing with the increased pressure (Boyle's law). Falls from shallow to deeper depths are more serious than falls from moderate to deeper depths under water.

In the two cases of mild "squeeze" reported in this communication, the negative differential pressure was small. The first case had been 35 feet below the surface for 17 minutes and the second case had

reached a depth of 36 feet before encountering trouble. Neither man had had any previous diving experience and each was unfamiliar with regulating the escape valve and air-inflow mechanism. If the escape valve is opened too wide, air will flow out of the helmet faster than it can be pumped in and a negative pressure will develop immediately. Conversely, if the escape valve becomes seated while air is being pumped into the helmet, a positive pressure will build up rapidly and "blow" the diver to the surface. In the two cases reported above, falls under water did not occur. We believe these volunteer divers became confused or alarmed and opened the escape mechanism too wide to maintain the proper pressure necessary for equilibrium within their helmets. In fairness to the diving crew, we wish to state that this identical apparatus was used during the remainder of the diving instruction on that day without any further mishaps or accidents.

A small negative pressure-differential within the helmet drives the diver's blood from the lower extremities and abdomen to the upper thorax, neck, and head. Blood from the inferior vena cava and right auricle of the heart will be forced into the superior vena cava. Since the superior vena cava and its contributing branches have no valves, back pressure from the over distention of these vessels will be exerted throughout the innominate, jugular, and cervical veins, through the vertebral, cerebral, and cerebellar veins and finally to the venous sinuses of the dura and the diploic veins of the calvarium. This cortical and meningeal plethora may account for the severe headache.

As a further result of this venous overfilling, great pressure is thrust upon the capillaries of the neck, face, head, scalp and conjunctivae with rupture and hemorrhage (ecchymoses) or with cellular extravasation resulting in the formation of petechiae. Overdistention of the capillaries also causes paralysis of the musculature of the vascular walls with resulting capillary-venous stasis, stagnant anoxia, or cyanosis. Administration of oxygen will aid in overcoming cutaneous, stagnant anoxia by restoring capillary tone and thus relieve the cyanosis, but cannot absorb extravasated blood. Hence, petechiae and ecchymoses (when present) will not disappear on administration of oxygen but rather will require from two to three weeks for absorption under ideal local circulatory conditions. Moreover, withdrawal of oxygen before capillary "tone" has been reestablished will quickly result in return of cyanosis (cf. the two cases herein reported).

The negative pressure-differential acts as a partial vacuum within the diving helmet and produces hemorrhages into the middle ear with (or without) rupture of the tympanum. It also causes the bleeding from the mucous membranes of the nasopharynx and the hemorrhage

from the pulmonary alveoli and gastric mucosa. This sucking action of the partial vacuum (similar in principle to "cupping") is exerted on the blood stream and in turn on the islands of hematopoietic cells in the bone marrow. This may explain the marked and almost immediate leukocytosis.

Diver's squeeze presents a clinical picture similar to traumatic asphyxia, "ecchymotic mask," or pressure stasis. It should not be confused with caisson disease which is an entirely different clinical entity both physiologically and pathologically. Squeeze is the result of a hydrostatic force. Caisson disease, or diver's paralysis, is a gaseous embolic phenomenon whose mechanism is in no way related to that of diver's squeeze.

SUMMARY

1. Two cases of diver's squeeze are reported.
2. The relation between the hydrostatic force at a given depth and the presence of a negative pressure-differential within the diving helmet constitute the mechanics of "squeeze."
3. The physiological factors are discussed.
4. The pathological changes in this condition are enumerated.
5. Treatment is supportive only.
6. "Squeeze" is a constant hazard in all diving operations and can be classified as a preventable accident.

JELLYFISH STINGS, SUGGESTED TREATMENT, AND REPORT ON TWO CASES ¹

By MONTGOMERY A. STUART, Captain, Medical Corps, United States Navy, and
T. D. SLAGLE, Lieutenant Commander, Medical Corps, United States Naval Reserve.

Contrary to popular belief, the sting of a jellyfish can be extremely dangerous, even fatal. The paucity of literature on the subject is probably due to the difference in the effect of contact with the animal in temperate and in tropical waters. In the former, the stings are usually merely painful, while in the latter, evidence points to the possibility of much more serious consequences. It is probable that little has been done in investigating the nature of the poison because the most serious reactions have occurred away from centers of research.

The sting of this animal is produced by thousands of nematocysts on the floating tentacles. When a trigger hair is touched at each of

¹ Received for publication September 26, 1942.

these organs, a tiny harpoon-shaped barb protrudes and penetrates the outer layer of the skin. No authoritative statement can be found as to the nature of the toxic substance injected. References to treatment are equally vague and unsatisfactory. The symptoms in all the reported cases from the tropics are practically uniform and although several species have attacked bathers, the same syndrome results in varying degrees of severity depending on the extent of contact.

A review of symptoms described in these cases indicates that the usual complex is as follows: Pain of a burning character at the site of contact, with redness followed by an urticaria-like wheal about 10 minutes later; muscle spasms before the rash is well established, involving most of the trunk muscles and sometimes many in the extremities; a flushing of the skin; moderate dilatation of the pupils; congestion of the respiratory mucous membrane; a profuse, thin, mucous, nasal and bronchial secretion; profuse lacrimation in severe cases; incessant cough with expectoration; spasm of respiratory muscles, leading to difficult respiration, and probably accounting for the patient's fear and anxiety which is frequently thought to be hysteria; and marked pain in abdomen and back, where large muscle groups are stony-hard with spasm.

Local treatment with alkaline washes gives little, if any, relief, but morphine in adequate doses does relieve the symptoms, which persist for only a few hours even without treatment. In most cases the urticarial rash becomes purplish, then vesiculates to form massive blisters not unlike those of second-degree burns. The cramps disappear, but patients report a susceptibility to muscle cramps for weeks afterwards when exercising or swimming. Swelling in the extremities may last for several weeks, and red discoloration at the site of contact, with some disturbance of sensation may be present for several months.

In 1908 Old (1) reported 9 cases from the Philippine Islands although he himself had not seen most of them. The above symptoms were usually present, in varying degrees. One boy of 14 died "in hysteria," in what seemed a recurrence of the symptoms after discharge from medical observation, several hours after the sting. All the other patients recovered. The treatment he mentions was morphine by injection, and the native remedy of sugar internally and vinegar externally. Wade (2) performed an autopsy in a case in which the patient died a few minutes after having been stung on the lower extremities. The history obtained from his companions was that he had cried out with pain while standing waist deep in water. When help reached him he was in collapse, and died a few minutes later. Although never submerged, the autopsy indicated death by "suffocation." There was general visceral congestion and status lymphaticus.

The following cases, of recent occurrence, are summarized because they demonstrate the severity of symptoms, and offer what seems to be

a satisfactory method of treatment. Two members of the armed forces on duty in Puerto Rico were stung while swimming at the beach on July 14, 1942. They were presented for medical treatment a few minutes later.

CASE REPORTS

Case 1.—B. L. H., a soldier, 20 years of age, had been stung across the back and left shoulder by a "Portuguese man-of-war." He was too restless and excited to give more history. His appearance was as though he were recovering from an epileptic convulsion. He was propped up on his elbows on the examining table, the skin of the whole body was flushed, the eyes opened widely, and the pupils moderately dilated. There was an expression of marked anxiety, and he breathed with great difficulty and irregularly by short inspirations and coughing expirations. He complained of severe oppression of the chest, and pain in the abdomen and lumbar region. Examination revealed boardlike rigidity of the lumbar and abdominal muscles. The patient moved on the table with difficulty because of muscle cramps in the extremities. The chest moved very slightly with respirations, but auscultation showed the lungs to be clear. The skin was raised in an urticarial rash in an area about the size of a man's hand over the right scapular region and in irregular streaks running across the left shoulder.

The patient was treated with a solution of sodium bicarbonate to the skin lesion, and morphine tartrate gr. $\frac{1}{2}$ subcutaneously. Because of the respiratory difficulty and pain of muscle cramps, 10 cc. of a 10 percent solution of calcium gluconate was given intravenously. After 4 cc. of the solution had been injected the patient expressed marked relief of pain and dyspnea. After the entire dose had been given, respiration was regular and free, the abdomen soft, and the cramps in the extremities gone. The patient still felt some pain in the lower lumbar region, and in the skin at the point of the sting. This pain gradually receded, and disappeared in about 2 hours.

The patient was transferred later to the Army station hospital from which he reported the next day by telephone that he felt perfectly well except for soreness of the skin in the right scapular region. He was seen again in 2 weeks and reported that he had a mild recurrence of muscle cramps of the extremities while swimming, which had never bothered him before contact with the jellyfish. At that time there was a sharply outlined, tortuous line of depigmentation over the area of contact with the tentacles. He felt no ill effects from the experience, but reported that scabbing had occurred in the skin lesion.

Case 2.—M. M. G., age 27, an ensign in the Navy, was seen at the beach as he came out of the water after having been stung by the same species of jellyfish. An urticarial rash had already appeared on the right wrist and across the anterior abdominal wall. The patient complained of severe burning pain in the area of contact. A few minutes later at the dispensary he complained of the same local pain, and a stiffness of the hands and shoulders of such a degree that he could not button his clothes nor raise his arms at the shoulder. He complained that there was a "load on the chest" and that he had to "lift my shoulders to get my breath."

There was profuse perspiration at the site of contact that reappeared as soon as wiped off. His right hand and forearm were markedly red and swollen and he was able to move them only with the aid of the other hand. He was anxious, restless, and complained bitterly of the constriction across his chest.

Because of the prompt relief obtained in Case 1 the same treatment was given, namely an injection of 10 cc. of 10 percent calcium gluconate intravenously.

The effect of the medication was instantaneous and dramatic. The patient immediately said that he had relief from cramps in the extremities and of oppression in the chest. Local burning of the skin was at once relieved but the discoloration persisted. Upon leaving the table, he easily raised both arms vertically to put on his shirt and picked up his bag with his right hand, which before the injection he could not move nor use to grasp any object. Four weeks later the marks of the tentacles were still plainly visible.

COMMENTS

In a recent memorandum the senior author described the symptoms produced by the bite of the black widow spider and pointed out that the treatment of choice was the intravenous injection of calcium gluconate. The similarity of symptoms observed in these patients who had been stung by the jellyfish to those suffering from spider bite, suggested that the same treatment would be indicated and immediate relief resulted.

While most cases of jellyfish stings cover a small skin area and are only painful locally, verbal reports from persons stung, as well as the meager literature on the subject reveal that the pain is intense, and that serious results do occur. A person might easily drown if in deep water at the onset of these cramps. Respiratory muscle spasm might be severe enough to cause death from asphyxia, as was feared in Case 1. Wade's case, previously cited, complicated also apparently by status lymphaticus, confirms this.

The theory has been advanced that the reaction to the sting of a jellyfish is merely that to be expected from a foreign protein to which the patient has been exposed previously. However, both the cases reported here denied previous contact with any kind of jellyfish, and both had come from inland communities where contact with marine animals was improbable.

Although morphine was used in Case 1, as well as bathing with an alkaline wash, no relief was noted until the injection of the calcium salt was begun.

The fact that stinging jellyfish are widely distributed in tropical and temperate waters, and that contact with them on bare skin produces painful and sometimes serious symptoms, makes it worth while to report the syndrome to be expected and to record a treatment that proved very satisfactory in two cases.

CONCLUSIONS

The authors emphasize the danger of the sting of the jellyfish, especially to bathers in tropical waters.

Two cases of stings by the "Portuguese man-of-war" are reported in which prompt relief of the major symptoms followed the intravenous injection of a solution of calcium gluconate.

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POSTOPERATIVE FOREIGN BODIES IN THE ABDOMEN¹

REPORT OF A CASE WITH A BRIEF RÉSUMÉ OF THE SUBJECT

By P. C. GUZZETTA, Jr., Lieutenant, Medical Corps, United States Navy

Unfortunately, because of the embarrassing legal complications which often result from their discovery, only a small percentage of the cases of foreign bodies left in the abdomen during surgery have been reported in the literature. There are many cases on record where the surgeon has discovered the absence of a surgical sponge, or an instrument, after the completion of an operation, and rather than admit his error, has hoped that it would become encysted or remain quiescent and cause the patient no harm. The end result, however, is usually the necessity of a second operation, as in the case reported here, or in many cases invalidism and death.

CASE REPORT

History.—X, seaman second class, USNR, is a slender, wiry, white American, 17 years of age, who enlisted in the Navy in April, 1942 and was attending a signal school during the onset of the following illness.

On September 16, 1942, the patient appeared at sick call complaining of right lower quadrant abdominal pain and nausea, without vomiting, for the previous 48 hours. The pain was of a steady, aching type, and remained localized in a small area surrounding a well-healed McBurney's incision. Bowel movements up to the time of admission had been normal, and there were no other symptoms.

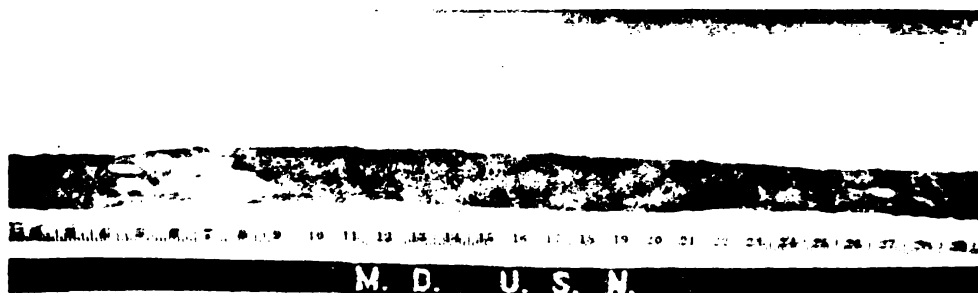
The patient could not recall a previous similar attack since January 1942, at which time he had undergone an appendectomy. This was before his enlistment in the service, consequently there was no entry concerning this operation in his health record. He did not know whether his appendix had been removed at that time. However, the patient did recall that drains were left in the wound at operation. The remainder of the past history was irrelevant.

Examination.—Examination revealed no abnormalities of the head or neck. The lungs were clear and the heart was found to be normal. The blood pressure was 125/80. Inspection of the abdomen revealed a well-healed 2-inch

¹ Received for publication October 19, 1942.

scar, apparently the result of a McBurney's incision. This scar was surrounded by an area of localized rigidity and moderate tenderness, approximately 3 inches in diameter. The remainder of the abdomen was comparatively normal. Gurgles were present. There was considerable tenderness noted on the right side during rectal examination. The rest of the physical examination was negative. Temperature was 98.6° F. and pulse 84 on admission. A white count at that time showed 10,200 leukocytes per cmm. The urine was normal. The patient was given nothing by mouth except water.

Preoperative course.—By the following morning, September 17, 1942, the patient's temperature was up to 99.4° F. and his pulse was 100. He appeared more acutely ill, and though the area of abdominal tenderness had not increased in size, it had become painful on very slight pressure. The leukocytes in the blood increased to 19,300 per cmm., and the differential count showed 52 percent neutrophils, 32 percent "stabs", 12 percent lymphocytes, 2 percent eosinophiles, and 2 percent monocytes.



1. 30-INCH STRIP OF SURGICAL GAUZE REMOVED AFTER 8 MONTHS IN ABDOMEN.

It was our opinion that the patient's previous operation had probably been merely the drainage of an appendiceal abscess, and that the appendix had again become acutely inflamed. He was therefore transferred to the hospital for exploratory surgery.

Exploratory surgical procedure.—Under general anesthesia (cyclopropane inhalation) a right gridiron incision was made just medial to the old scar. On opening the peritoneum considerable serous fluid was noticed in the abdominal cavity. On palpation a firm lemon-sized mass was felt approximately 1 inch above the upper end of the incision. This was found to be a well localized, heavy-walled abscess containing about 1 ounce of thick yellow pus, and a 30-inch strip of gauze evidently used for packing during the previous operation. The gauze was removed, the pus sponged up as well as possible, and 4 grams of powdered sulfanilamide placed in the abscess cavity. There was no evidence of bowel injury present, and the appendix had been removed previously. A rubber-tube drain was inserted into this infected area, and a Penrose drain placed in the right pelvic fossa; both drains left the abdomen through the central portion of the sutured wound. The abdominal wall was closed in layers about the two drains, interrupted sutures being used throughout. The immediate postoperative condition of the patient was satisfactory.

Postoperative course.—Intravenous fluids were given freely during the first 48 postoperative hours. During this period 1-gram doses of sulfanilamide dissolved in 50 cc. of distilled water were also given parenterally every 4 hours.

Drainage from the wound was only moderate, and the drains were removed approximately 1 inch daily. On the third postoperative day sulfathiazole was started by mouth in doses of 1 gram every 4 hours, and the intravenous sulfanilamide was discontinued. The drains and dermal sutures were completely removed on the fifth postoperative day, and the remainder of the patient's convalescence was uneventful except for a sharp 24-hour rise in temperature on the seventh day. This proved to be caused by slight overdosage with sulfathiazole and responded immediately to discontinuance of the drug and to forced fluids.

The patient was allowed to be up and about for short periods of time on the ninth postoperative day, and gradually increased his activity thereafter. The purulent drainage decreased in amount until October 9, 1942, at which time it ceased entirely.

On October 12, 1942, the patient resumed his classes and was advised to restrict his physical activities for several months and to report to the sickbay regularly for observation.

DISCUSSION

In 1909, Crossen (1) reviewed the literature on foreign bodies left in the abdomen during surgery, covering a period of 50 years, from 1859 to 1909. He found during this time 172 reported cases of sponges, and 50 cases of hemostats or other foreign bodies left in the abdomen during laparotomy. The mortality in the sponge cases was 30.8 percent, and for the other foreign bodies was 28 percent. Greenhill (2) took up his review where Crossen left off, and from 1908 to 1932, 24 years, found 109 reported cases in American and foreign literature. This series contained 58 cases of sponges and 51 cases of hemostats and other objects which were left in the abdomen. In this series, there was a mortality rate of 17.6 percent. This lowering in the death rate was due both to the improvement of surgical technic during this period, and to the fact that in many of these cases the accident was discovered and the abdomen reopened within a week of the first operation. The complications increased very rapidly with the period of time the foreign bodies were allowed to remain in the peritoneal cavity.

In many cases the presence of an intra-abdominal foreign body, following surgery, can be suspected when a patient does not recover from his operation as rapidly as expected. The presence of obscure abdominal pains, and frequently nausea and vomiting, during convalescence, should always arouse suspicion if these untoward symptoms are not easily explainable.

The symptoms depend upon whether the foreign body is septic or aseptic. If septic, peritonitis is the usual result, with very frequently a fatal outcome; however in the case of aseptic foreign bodies there is a strong tendency for encapsulation, with acute symptoms appearing after variable periods of time. A case demonstrating this characteristic was reported by McShane (3). In 1920 his patient was operated

upon for the repair of a ventral hernia caused by a previous operation. From that time until 1938 she had periods of nausea and mild abdominal pain. In 1938 she had an attack of severe pain and vomiting, which was diagnosed as intestinal obstruction, but at operation it was found to be caused by a surgical sponge left in the abdomen in 1920, 18 years previously.

Rarely, no symptoms whatsoever are produced. Foley (4) reported a case of this type, in which a surgical sponge surrounded by a thick omental capsule was found in the abdomen accidentally during necropsy in a 30-year old woman. The foreign body was not related to the cause of death, and as far as could be determined by the history, had not produced any symptoms.

Frequently abdominal foreign bodies are extruded into the lumen of a viscus, usually the bowel or bladder. This is a serious complication, but not necessarily fatal. Hartz (5) writes of an operation for full term ectopic pregnancy, in which a gauze sponge measuring 36 by 18 inches was left in the abdomen, and expelled through the rectum 75 days later, with complete recovery. This same author reported another interesting case of an asymptomatic encysted sponge, surrounded completely by omentum and freely movable in the abdomen, which was discovered accidentally during an operation for the removal of a uterine fibroid.

The tendency for foreign bodies in the abdomen to erode the surrounding viscera was also illustrated in a case recorded by White (6). His patient presented vague complaints of low abdominal pain, and on vaginal examination he could see the tip of a hemostat protruding from the cervix. She had undergone a laparotomy 19 years previously and the hemostat had eroded both the uterine wall and the pelvic colon. The instrument was removed by the abdominal route, and recovery took place after a stormy convalescence.

A considerable number of precautions should be taken, in an attempt to prevent the type of case which was presented here. First in importance, probably, is an assurance by the surgeon that all sponges and instruments are accounted for at the close of each operation. Small sponges should be cleared from the operative field just before the peritoneum is opened in abdominal surgery, and thereafter only large laparotomy sponges with metal rings attached should be used. An x-ray examination will then determine the presence of a sponge if there is any suspicion postoperatively. There are several other safeguarding sponge methods, which have been suggested in an attempt to prevent this most common foreign body following abdominal surgery. Thorek (7) advises the use of Crossen's "saddle-bag" arrangement; one bag containing a strip of clean sterile gauze 3 inches wide and 10 yards long, which is attached to the bottom of the bag and is used as needed, the soiled portion being placed in the

other half of the bag. Other surgeons have made use of a metal-rod sponge carrier to which all sponges are attached by a long tape and metal ring. As the sponges are used they can be moved out of the surgical field. All instruments should also be checked regularly for loose parts, as a considerable percentage of foreign bodies are screws and other small parts of instruments. Finally, but of considerable importance, is the use of uniform methods in assistance and operative technic.

CONCLUSIONS

A case report of a foreign body in the abdomen due to previous surgery was presented. The literature on this subject was reviewed, and it was found that this condition occurred more frequently than would be expected, and that the mortality was still about 20 percent due to the many complications that may arise. A few suggestions were given for the prevention of these avoidable surgical misfortunes.

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INTRAPERITONEAL HEMORRHAGE FOLLOWING APPENDECTOMY¹

REPORT OF A CASE

By O. B. MORRISON, JR., Commander, Medical Corps, United States Navy, and
W. R. GRISWOLD, Lieutenant, junior grade, Medical Corps, United States Navy

CASE REPORT

The patient reported to the sickbay aboard ship with characteristic signs and symptoms of acute appendicitis. Past history was essentially negative, with no evidence of serious illness or injury. He stated that the first symptom noticed was pain in the right lower quadrant which had occurred 2 hours before he reported to the sickbay.

Appendectomy was performed under spinal anesthesia (150 mg. procaine crystals), an interesting feature being that great difficulty was experienced in

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obtaining sufficient spinal fluid to dissolve the crystals. Several lumbar punctures were done which resulted in "dry taps"; finally one-half cc. of fluid was obtained which proved barely sufficient to dissolve the procaine. A completely satisfactory anesthesia however resulted.

A right rectus incision was made and appendectomy performed in the usual manner. The appendiceal stump was doubly ligated but was not inverted. After ligation of the meso-appendix it was noted that there was a small "bleeder" adjacent to the base of the appendix. This was clamped and controlled by a ligature on a needle. This ligature was carefully placed and tied. The operative field remained perfectly dry and the abdomen was closed in layers. The actual surgery was completed in approximately 20 minutes.

Following operation patient was placed in bed and given 1,000 cc. of 5 percent glucose in normal saline intravenously. Eight hours later his temperature rose to 102° F., pulse 120 and respirations 30. The patient began hiccupping, especially noted whenever he attempted to take a small sip of water. The hiccoughs were controlled with great difficulty and for a few hours at a time. His condition remained unchanged for a period of 2 days and he then began to complain of severe pain in the upper right quadrant of the abdomen, and hiccoughs became more severe and persistent. Tympanites developed and a Wangenstein suction was instituted. During this time he was given 3,000 cc. of 5 percent glucose in normal saline each 24 hours. Only partial relief was obtained by this procedure and it was discontinued after 48 hours. A complete blood study at this time revealed a RBC of 3,800,000, Hb. 85 percent and WBC of 14,000 with differential count within normal limits. There was no evidence of "air hunger" but respirations remained rapid and difficult. The elevations of pulse and temperature persisted. The patient continued to suffer with hiccoughs and tenderness in the right upper quadrant.

On the fifth postoperative day it was noticed that there was a slight icteric tinting of the sclera. Tenderness was localized in a small area in the right midaxillary line at the level of the twelfth rib. The peritoneum was under great patient and his signs and symptoms suggested a subdiaphragmatic abscess and surgical intervention was considered indicated.

Accordingly under local procaine anesthesia an incision was made in the right midaxillary line at the level of the twelfth rib. The peritoneum was under great tension and bulged up into the incision. When it was incised approximately 2,000 cc. of thick, dark red, bloody fluid containing many clots was evacuated. One gram of sulfanilamide (sterile powder) was placed in the wound, and cigarette and tube drains inserted. Stained smears of the fluid which had been removed from the abdomen contained red cells in varying degrees of disintegration, and innumerable gram-positive cocci in both long and short chains. The organisms could not be positively identified with the facilities available aboard ship but they were believed to be hemolytic streptococci. Sulfanilamide therapy was immediately started by mouth.

The patient's condition however became steadily worse and deep and definite icterus developed.

The wound during the following 24 to 36 hours discharged copious amounts of the same very dark, bloody red fluid and then changed to bright red with a slight fecal odor. On the seventh postoperative day the original right rectus incision was completely healed. He was given repeated intravenous injections of plasma and transfusions of citrated blood, but his condition remained critical. The drainage remained bright red in color and profuse in amount.

As a last resort an exploratory laparotomy was done through the original appendectomy incision. The peritoneal cavity was found to contain approxi-

mately a liter of dark, bloody fluid with entire peritoneal wall and gut in this area covered with densely adherent sanguinopurulent clot. The appendiceal stump was found to be securely ligated. The meso-appendix was almost completely eroded away. There were no active bleeding points, but a generalized oozing from the area just posterior to the appendix stump at the ileo-cecal junction. Several atraumatic purse-string sutures were placed in the peritoneum at the site of the oozing and it finally subsided. This incision was closed in layers without drainage after dusting the surface with sulfanilamide powder.

The patient's condition remained critical and his demise was expected momentarily during the next 2 days. He was continued on plasma and blood transfusions on alternate days. An interesting and distressing feature was the occurrence of severe chill and temperature rise following each blood transfusion, but no reactions followed the administration of the plasma. The reactions from the blood transfusions were finally controlled by giving sodium bicarbonate grains 40, and epinephrine one-half cc. immediately preceding transfusion. Each time this procedure was carried out there was no reaction from the transfusion, but reaction always followed if it was omitted. The hiccoughs disappeared shortly after the exploratory laparotomy was performed, and there was prompt decrease in the drainage from the incision in the upper right quadrant. The tract was irrigated twice daily with 1:3300 azochloramide solution. The right rectus incision again healed by first intention and the patient continued to make slow but sure recovery. On the 18th postoperative day he was allowed up and about. A few days later he was transferred to a foreign naval hospital.

The necessary facilities for doing blood cultures or for completely identifying the infecting organisms were not available. It is the opinion of the authors, however, that an acute fulminating infection with hemolytic streptococci caused erosion of the tissues about the meso-appendix.

Ligation of the meso-appendix was most carefully done and checked before closure in the first instance.

The case is of interest not only from a medical and surgical aspect, but also from the angle of being confronted with a case of this type aboard a ship which was operating thousands of miles from a naval hospital and under wartime conditions. Under such conditions the facilities for caring for such a case are far from ideal but we consider that we were extremely fortunate in being able to bring the case to a successful conclusion in spite of certain unavoidable deficiencies in our armamentarium.

SPONTANEOUS RUPTURE OF THE RIGHT VENTRICLE¹

By ROBERT W. QUINN, Lieutenant, Medical Corps, United States Naval Reserve

Spontaneous rupture of the heart is a rare cause of death and it is

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not unusual for many doctors to practice a lifetime without observing it.

As far as is known the first description of cardiac rupture was recorded by William Harvey in 1647. The great Morgagni in 1765 collected 10 cases and it is of interest to note that he himself died of spontaneous rupture of the heart. Undoubtedly many instances of this condition have gone unrecognized, and on the other hand many recognized cases have not been reported. In 1925 Krumbhaar and Crowell collected 654 cases (1). Davenport (2) in 1928 added 92 more, and Benson, Hunter, and Manlove (3) added 40 additional cases bringing the total of recorded cases in 1933 to 786.

The incidence of cardiac rupture varies with different observers. Krumbhaar and Crowell cite 7 ruptures in 16,000 autopsies at the Philadelphia General Hospital; Meyer reported 7 in 13,000 in Munich; the Leipzig series reports 9 in 8,000. In 1925 De La Chapelle recorded 20 cases of rupture among 15,000 autopsies in the Medical Examiners Service in New York City. The figure of 40 ruptures in 7,000 autopsies reported by Benson, Hunter, and Manlove is somewhat higher than other figures. The incidence of ruptured heart as a cause of death in 5,339 cases examined at the San Francisco Coroner's Office in the past 5 years was approximately 1.5 percent or 80 cases. These figures lead one to suspect that rupture of the heart is not as uncommon as heretofore believed (4).

By all odds the most common etiological factor is coronary artery arteriosclerosis with occlusion, resulting in myocardial infarction and necrosis. In the 40 cases reported by Benson, Hunter, and Manlove, one was probably of syphilitic origin, another a dissecting aneurysm of the sinus of Valsalva and all the rest were attributable to disease of the coronary arteries.

In the series reported by Krumbhaar and Crowell which included cases reported by Quain, Minet, and Robin, 58.3 percent were males and 41.7 percent females. As might be expected, the largest percentage of cases appeared in the fifth, sixth, and seventh decades. Death is usually sudden, especially if the left ventricle be the one ruptured. However life can apparently be maintained for a few hours even with a ruptured ventricle. The patient in this case report lived about $23\frac{1}{4}$ hours. In the same report by Krumbhaar and Crowell the sites of rupture were as follows: Right auricle 5.7 percent, left auricle 2.0 percent, right ventricle 10.2 percent, left ventricle 79.7 percent, and miscellaneous 2.4 percent.

In times such as these it might be reassuring to our men in the armed forces and their folks at home that it is practically certain they will not die of a broken heart.

CASE REPORT

Family history.—Not contributory.

Past history.—Patient was known to have had hypertension since September 6, 1939, at which time his blood pressure was 174/94. No subsequent determinations were made. Systemic inquiry: Essentially not contributory; however it was learned through the patient's division officer that he had experienced chest pains of a few hours' duration 3 months prior to the onset of his present illness.

Present illness.—On the morning of July 20, 1942, he noticed a chilly sensation; at about the same time a dry nonproductive cough and a tickling sensation under his sternum occurred. Following this he felt feverish, so in the evening of this day he presented himself at the sickbay. He was placed on the sick list and put to bed.

Physical examination.—Patient is an obese, middle aged, swarthy male of rather stocky build, not appearing acutely ill. He is active and cheerful but slightly cyanosed. Temperature 101° F., pulse 80, respiration 20. Respiratory system: Chest flares anteriorly and the anteroposterior diameter is slightly increased. Normal to palpation and percussion. On auscultation dry squeaky rhonchi are heard throughout the chest, disappearing after coughing. Cardiovascular system: Radial pulses regular and equal (80 per minute). Slight cyanosis of the lips but no edema, dyspnea, or orthopnea. No apex beat felt. Precordial area within normal limits to percussion. Auscultation: Sounds well heard, no murmurs or rubs. Back: Increased lumbar lordosis and thoracic kyphosis due to his heavy protuberant abdomen. The rest of the examination reveals nothing noteworthy.

Course.—July 22, 1942: Temperature 101.6° F., pulse 86, respiration 18. Patient feels much better and wants to get up. Occasional coarse bronchial r le and slight increase in size of posterior cervical and axillary lymph nodes. Posterior pharyngeal mucosa slightly injected. Influenza suspected.

July 23, 1942: Patient felt fine, got up and walked aft to the carpenter shop to see how things were going. Temperature 100.8° F., pulse 76, respiration 18. Occasional post-tussic moist r le in the left anterior superior chest. Rest of physical examination normal. While examining the patient who was standing, he became faint and had to lie down, quickly recovering however.

July 24, 1942: 8:45 a. m.—Temperature 99° F., pulse 70, respiration 18. Posterior pharynx more injected. Chest clear, heart sounds as on previous examination. Patient was cheerful and said he felt well.

9:00 a. m.—Patient was lying quietly in his bunk when a corpsman suddenly noticed that he was very pale, gasping for breath, and gritting his teeth with pain. The pain was excruciating and was located across his anterior chest radiating down the left arm.

In less than 5 minutes he was transferred to a surgical bed, placed in the orthopneic position, given $\frac{1}{4}$ grain morphine sulfate subcutaneously and $\frac{1}{4}$ grain intravenously, and 100 percent oxygen was administered at a rate of 8 liters per minute through a B. L. B. mask. His pain was relieved almost immediately after administration of the intravenous morphine.

9:20 a. m.—Patient was ashen gray and cyanotic; pulse and blood pressure readings unobtainable. Respiration 30 (Cheyne-Stokes), apex rate 138 and regular. No pulmonary edema. Venous pressure increasing to above normal.

10:15 a. m.—Respiration practically all diaphragmatic. Very little excursion of the chest. Cyanosis and Cheyne-Stokes respiration still present. No pulmonary edema. Apex rate 130 with frequent extra systoles. Unable to feel

pulse. Patient comatose, venous engorgement of jugular vein marked, indicating high venous pressure.

11:00 a. m.—Condition about the same. Cyanosis persistent in spite of 8 liters of 100 percent oxygen per minute. Patient comatose.

11:52 a. m.—Patient had a convulsion following which he died.

Laboratory findings.—WBC 11,300, differential—segs 63, lymphs 31, monos 4, trans 1, eos 1. Erythrocyte sedimentation rate (Cutler) 27 mm. in 60 minutes.

Postmortem examination.—A complete postmortem examination was performed, but only the heart will be described in detail since it was in that organ that the main pathological lesions were located.

On opening the pericardial cavity about 350 cc. of clotted blood was found. The superior and inferior vena cavae were intensely engorged with dark red blood and the right auricle was tense and dilated. The right ventricle presented, but was collapsed. Just under the epicardium were numerous hemorrhages. The right ventricular wall was soft and fluctuant as in a cyst and the whole chamber was partially collapsed. At the apex the ventricular wall was puckered and bloody and there was a small tear through the epicardium communicating with the right ventricular cavity.

The aorta and pulmonary artery were then tied off and the heart removed. It weighed 480 grams. The right auricle was dilated and engorged with blood. The tricuspid valve was normal to observation and admitted 3 fingers; it measured 120 mm. in circumference. On opening the right ventricle approximately 50 cc. of clotted blood was removed from between the epicardium and myocardium. The right ventricular wall was 8 mm. thick in its mid-portion, thinning out to 2 to 3 mm. at the apex. Practically the entire right ventricular musculature was soft and at the apex it was extremely friable. At the apex was a small ragged tear extending through to the pericardial cavity.

The epicardium was separated from the myocardium over an area occupying practically the entire anterior portion of the right ventricle. In places small bits of myocardium were adherent to the epicardium as if it had been torn loose. This cavity was occupied by about 50 cc. of clotted blood. The endocardium of the right ventricle in its lower two-thirds was easily torn and lusterless. The pulmonary valve cusps were normal and the valve was 75 mm. in circumference. The left auricle was normal and empty. The mitral valve cusps were thin and shiny and no evidence of thickening was present. Its circumference was 75 mm. The left ventricular wall was considerably hypertrophied, measuring 22 mm. in thickness in its mid-portion. The chamber was empty and the left ventricular endocardium, myocardium, and epicardium appeared grossly normal. The aortic valve showed slight thickening in small areas and was 85 mm. in circumference.

The intima of the ascending aorta was slightly roughened but not grossly sclerotic. The coronary artery ostia were patent but there was a small arteriosclerotic plaque near the opening of the left coronary artery. The coronary arteries were open throughout. The left coronary artery and its interventricular branch were patent throughout, with occasional arteriosclerotic plaques felt, particularly in the first 2 cm.

The right coronary artery was patent in its first 4 cm. However at this point the lumen was filled with a firm dark red adherent thrombus about 2 cm. long. This thrombus was firmly adherent, and seemed to be attached to the intima by numerous minute strands. Beyond this point the lumen was patent. The right marginal and anterior ventricular branches were likewise patent. Throughout its length the right coronary artery and its branches were very hard, and cut with a grating noise in many places in marked contrast to the left coronary artery.

It is of interest to note that the lungs were pale and partly collapsed when the pleural cavities were opened. They were crepitant and there was no consolidation or edema.

The liver was enlarged and engorged with dark red blood. Its cut surface oozed dark red blood as did the cut surface of the enlarged and engorged spleen.

There was no dependent edema or ascites.

Both kidneys appeared grossly normal and weighed 170 and 180 grams respectively.

Microscopical examination.—Sections of myocardium show evidence of infarction. There are areas of necrosis with heavy deposits of blood and fibrin in places where myocardial fibers have been destroyed; also, areas in which the muscle has been replaced by vascular granulation tissue. Patches of fresh necrosis are also present, some of which show hemorrhage while others are heavily infiltrated with leukocytes. No large coronary arterial branches are seen, but several small vessels show sclerosis without complete occlusion. A portion of kidney shows fairly normal architecture, generally good preservation of tubules and glomeruli, but a moderate degree of sclerosis in large and medium sized blood vessels.

SUMMARY

There are several unusual features about this case which are difficult to explain satisfactorily. First, the clinical course was very misleading. The patient had no signs and symptoms suggesting acute coronary artery occlusion until $2\frac{3}{4}$ hours before his death and these signs and symptoms proved to be due to myocardial rupture and not acute coronary artery occlusion as was suspected clinically. The leukocytosis and increased erythrocyte sedimentation rate demonstrated at this time, and the persistent fever and cyanosis throughout undoubtedly accompanied the myocardial infarction which had occurred several days previously. The only sign which might have led one to expect impending cardiac failure or a recent coronary artery occlusion was the persistent cyanosis.

The excellent exercise tolerance which he maintained until the last in spite of the great myocardial damage is remarkable and puzzling. At no time previous to the time of rupture did he complain of precordial pain or dyspnea and at no time were dependent or pulmonary edema, increased venous pressure, or any other symptoms and signs of cardiac decompensation excepting cyanosis demonstrable.

The dizziness and faintness experienced the night before his death were probably a result of temporary deficiency in the cerebral blood supply which was indirectly a result of right ventricular failure, the right ventricle failing to supply the left ventricle with enough blood to maintain adequate cerebral circulation.

Death following rupture of the left ventricle is usually practically instantaneous, but apparently rupture of the right ventricle is compatible with life for a few minutes up to several hours as was the case with this patient.

The cause of death was right ventricular failure, partially a result of the inability of the necrotic myocardium to function properly and partially because of increased external pressure on the right ventricle because of the large amount of extravasated blood contained in the pericardial sac.

CONCLUSION

A case of coronary artery occlusion with unusual clinical features followed by rupture of the myocardium is presented along with appropriate historical and statistical remarks.

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FEMORAL VEIN LIGATION FOR THROMBOPHLEBITIS WITH PULMONARY EMBOLISM¹

By J. K. PATTERSON, Commander, Medical Corps, United States
Naval Reserve

Fatal pulmonary embolism, once thrombophlebitis has occurred, is often an unpreventable and unexpected tragedy in surgical conditions. Through increasingly improved technics and chemotherapy, mortality has fallen from various operations and from formerly hopeless situations, such as staphylococcus septicemia; but there has remained a supposedly irreducible minimum of deaths due to embolism. Recent work, however, tends to show that this minimum may be reduced with further adoption of technics now at our disposal. A short consideration of such a technic is the subject of this paper. A case of pulmonary embolism complicating thrombophlebitis, arising from staphylococcus septicemia, treated by femoral vein ligation, with recovery, will be presented as an illustration of the efficacy of such treatment.

The mode of development of the thrombus which, on its dislodgement, leads to pulmonary embolism is of interest. Sepsis must not be

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overlooked as the usual fundamental cause, though aseptic thrombi do occur. Through the effect of bacterial toxins the intima of small veins loses its vitality. If, adding to this loss of vitality, the blood flow past this damaged intimal surface becomes stagnated or obstructed, with consequent lowering of nourishment for the intimal cells, thrombus formation is encouraged. This is first evinced by the adherence of fibrin to the damaged area, with development of a hyaline thrombus. Superimposed upon this may arise a white or agglutination thrombus; upon which in turn, from liberation of thrombokinase by the platelets of the white thrombus, the surrounding stagnant blood is coagulated into a dangerous red thrombus. The latter, very similar to a postmortem clot, may progress up the entire blood column in the vein. It is attached but loosely to the vein wall, and usually only at its site of origin. It is friable, and may be dislodged or broken easily (7).

Certain factors, which are common to all conditions (e. g. sepsis, the postoperative period, and the puerperium) where thrombus formation most frequently occurs, predispose to the formation of these clots. These are particularly: Increased blood fibrinogen, shift in the albumin-globulin ratio toward the globulin side, dehydration with increased blood concentration and/or secondary anemia, leukocytosis, and increased platelet count. Normally the platelets are repelled by a common negative electrical potential. The above changes reduce this potential, favor agglutination, and supply a rich source of thrombokinase.

More obvious factors too are involved—such as the presence of infection adjacent to the vein wall, actual mechanical or chemical trauma to the intima, shallow breathing, with consequent reduction in blood flow and poor oxygenation, long periods of immobilization of the limbs, tight abdominal binders restricting blood flow, and intestinal paralysis. Thrombophlebitis of the leg veins occurs more frequently on the left side. This is supposed to be due to the compression of the left iliac vein, at the point where the iliac artery crosses over it. Thrombophlebitis is not unusual after obstetrical or gynecological procedures, apparently because of the close proximity of involved veins. Previous involvement of the leg veins by phlebitis trebles the incidence of postoperative thrombosis and embolism (5).

Prevention of thrombophlebitis has been aimed, from several directions, to attack the causes as outlined above. Thus, the use of carbogen inhalations postoperatively will increase blood flow, as well as raise the oxygen content of the blood, and indirectly the vitality of the intimal cells. The use of thyroid, local massage, and change of position are used to encourage blood flow. Heparin has been used to

reduce coagulability of the blood. Infusions of glucose, saline, or plasma reduce blood viscosity. Careful, sharp, and clean operative technic is of great obvious importance. Early control of infection by chemotherapy will also be of value as a preventive.

One of the most ingenious, yet practical of the modes of prevention is that recommended by Frykholm (1). He advises that obstetrical patients (1.3 percent of whom develop phlegmasia alba dolens) (6) be placed in a bed the head of which has been elevated about 1 foot. This causes the veins of the legs to fill, preventing adherence of intimal walls with consequent stagnation. Moreover, the patient must frequently scramble up in bed, thus emptying the veins periodically. His studies convince us that the great majority of pulmonary emboli of extracardiac origin arise from the deep veins of the lower extremities. The femoral veins are involved secondarily from the plantar veins, the veins of the calf or adductor muscle groups, or the visceral pelvic veins. Ninety percent of all thromboses occur in the veins of the lower extremities.

Once the thrombus has formed, however, treatment until recently has been expectant, with rest of the affected limb, sedatives and supportive measures such as blood transfusion. After the temperature had been normal for a week or so the patient was tried out of bed; but no assurance could be given that fatal pulmonary embolism, or local gangrene requiring amputation (4), would not occur in spite of these measures. Owing to long continued swelling with protein-rich edema fluid, fibrosis often resulted in permanent enlargement of the leg.

Recent work on femoral vein ligation offers us a positive and hopeful therapy. With the affected vein ligated and cut, embolism cannot occur from that vein (2). This procedure will prevent embolism, add to the patient's comfort and greatly shorten the convalescence.

A further aid is to be found in the recent development of a radiographic method of early diagnosis, through the injection of diodrast into the small vein behind the external malleolus. With wider application of this diagnostic aid, leading to earlier treatment, sudden death of many patients in whom signs and symptoms are indefinite, may be prevented (3).

Early signs which, however, are significant even without x-ray are: Unexplained leukocytosis, slight swelling of the leg, pain in the calf, foot, or over the femoral triangle, swelling of the small veins of the ankle as compared with those of the opposite leg, perhaps associated with signs of small pulmonary infarcts, such as chest pain. If these occur serious trouble may be averted by femoral vein ligation. All definite cases of deep thrombophlebitis of the lower extremity should be treated by this procedure (2). It may be repeated on the opposite

side should a thrombus develop there. The condition is frequently bilateral. The operation is minor and should carry no risk. Collateral circulation is adequate and is improved, probably reflexly, by this method. This is shown by rapid subsidence of edema in cases so treated. The suffering, disability, and risks it avoids are great. One is reminded here of the analogous procedure of ligation of the jugular vein, in lateral sinus thrombosis.

CASE REPORT

History.—L. B., sergeant, USMCR, aged 24 years, was admitted to the hospital May 16, 1942.

A week before admission the patient developed a small furuncle over the sternum. With no history of injury, pain began in the right hip 3 days later, causing him to limp. Swelling over that hip had been present for 3 days; moderate diarrhea for 2 days; anorexia, with one emesis, and headache for 1 day on admission.

The past history was essentially negative.

Physical examination.—A well developed, muscular young man acutely ill, complaining of pain in the right hip. Temperature 102.4° F., pulse 92, respiration 20. There was a small, flat, unhealed raw area, at the site of the recent furuncle over the midsternum. Fullness was noted just below the right inguinal ligament, and laterally over the great trochanter. Tissues around the hip were tender, with muscle guarding of this joint. Heart normal. Lungs clear.

Laboratory findings.—Urinalysis negative. Stool negative for ova or parasites. Sedimentation time 28 min. RBC 4,750,000; WBC 10,200; 10 bands; 72 segs; 7 lymphocytes; 11 monocytes. Repeated blood smears for malaria were negative. Blood culture showed hemolytic staphylococcus. Organisms of the same morphology were found on smear of the partially healed furuncle. Fluid removed by aspiration of the swollen tissues around the hip was negative by culture.

Preoperative course.—On admission the patient was placed on sulfathiazole, gram 1 every 4 hours, bed rest and supportive measures. The diarrhea promptly cleared. He was given repeated transfusions of 250 to 500 cc. of blood, receiving 23 of these during his hospital stay.

One week after admission, with the temperature still fluctuating from 101° to 104° F., areas of dullness were first noted in the left upper and right lower lobes of the lungs, with chest pain and moist râles. Sputum examinations were repeatedly negative for pneumococcus or acid-fast organisms. There was pain in the right knee and calf muscles, but as the leg was not swollen this was attributed to the hip involvement. X-ray of the right hip was negative. Respirations were 44, pulse 110, temperature 104° F. Blood culture still positive. He was placed on the critical list; sulfathiazole and blood transfusions continued.

Twenty-four hours later the right lower extremity showed pitting edema. There was extension of the chest findings. A small amount of bloody fluid removed by thoracentesis was negative, on smear, for organisms. As thrombophlebitis of the deep veins of the right leg with multiple small pulmonary emboli was now considered obvious, the right femoral vein was ligated.

Operative procedure.—Ligation was effected at a point 4 centimeters below the right inguinal ligament, distal to the origin of the profunda femoris, through a short linear incision under novacaine. The medial edge of the sartorius muscle was elevated, and the femoral vein carefully separated from the overlying femoral

artery. The vein was ligated twice and cut between the ligatures. As is usually the case, no clot was seen at the point of ligation. Following this, as an added precaution, a right paravertebral block at L 1-2-3-4 was done with 1 percent novocaine, for its beneficial effect on pain and collateral circulation, by Dr. Leonard T. Furlow.

Postoperative Course.—The next day pain in the leg was less and the morning temperature reached normal for the first time since the patient's admission. In 2 days all swelling had gone from the leg except at the original site around the hip. His lung pathology cleared up slowly, with no evidence of fresh emboli. The blood culture remained positive for staphylococcus for 5 more days, thereafter remaining negative.

He had, however, a long and febrile stay in the hospital due to the original osteomyelitis of the right ilium, which was finally demonstrable by x-ray. This required surgical drainage. He was able to be transported back to a base hospital after 2½ months in the field hospital on August 4, 1942. RBC on discharge 4,190,000, WBC 10,950. Lungs clear. Blood culture negative. Owing to application of a cast to the right hip, there was a partial return of painless swelling of the right lower leg a month after ligation, but no further embolism or evidence of phlebitis appeared.

SUMMARY

Present methods of active treatment of thrombophlebitis afford a means of preventing fatal embolism, hasten recovery, and add to the comfort of the patient.

A case is cited of a critically ill patient with osteomyelitis, septicemia, and resultant thrombophlebitis complicated by recurrent pulmonary embolism, who recovered following ligation of the affected vein. Edema promptly disappeared, and the pulmonary condition cleared without recurrence.

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CHRONIC BRUCELLOSIS WITH RECURRENT IRITIS, HEMIPLEGIA, AND DEATH FROM A COMPLICATING DIFFUSE ENCEPHALITIC ENCEPHALOMALACIA¹

By HAROLD J. HARRIS, Lieutenant Commander, Medical Corps, United States Naval Reserve

The case history presented below is of interest for the following reasons:

1. The illness occurred in a 24-year-old enlisted man.
2. Many of his numerous complaints had been ascribed to neurosis.
3. Chronic brucellosis is a common disease, often undiagnosed, or misdiagnosed as neurosis.
4. Gastro-intestinal symptoms are common in brucellosis; ocular manifestations and a variety of neurologic manifestations are not rare.
5. Death is often the only means of proving that real illness existed during life.

CASE REPORT

Present illness.—R. H., age 24 years, was admitted to the hospital on July 7, 1941 with a diagnosis of duodenal ulcer. His chief complaint was epigastric pain of 4 years' duration. The pain usually came on soon after eating and lasted from 1 to 3 hours, with little relief from food or alkalis. He was occasionally nauseated but vomited infrequently. X-ray diagnosis of peptic ulcer had been made by a civilian physician prior to admission. Epigastric pain occurred occasionally in the night. He also complained on admission of fatigue, vague pains in his legs, and a cough with a white, somewhat foul sputum. There had been no loss of weight.

Family history.—Family history included cancer of the bowel in the patient's mother and poliomyelitis and tuberculosis in one sister. His father and two brothers were living and well.

Past history.—The patient was born in Kansas and had spent vacations in Colorado, California, and New Mexico. He had worked as foreman in a meat packing plant before entering the Naval Reserve in October 1940. His health had never been robust. For the past 8 years he had had chills and fever of unknown etiology each summer, the attacks lasting from 3 to 5 weeks. He had been reasonably well between attacks. For the past 5 years he had had attacks of iritis occurring four or five times yearly, accompanied by low-grade fever. For 3 or 4 years he had had frequency of urination with a sense of burning.

Examination.—Physical examination revealed a slender, undernourished man of 24 years who was alert, intelligent, and cooperative. Blood pressure was 110/70, Kahn test was negative, complete blood count was within normal limits, blood films showed no malarial parasites. Chest, gastro-intestinal and sinus x-ray studies were negative. Basal metabolism rate was +5. Pulse ranged from 90 to 120 and there was some tremor of the fingers at times. There were no other significant findings.

Course.—He continued to complain of pains in his legs, weakness and fatigue, and epigastric distress of varying severity, throughout his 7 months of hospital stay.

¹Received for publication September 4, 1942.

On September 4, 1941 an acute iritis developed and improved after sulfathiazole was begun 6 days later; relapse occurred 2 days afterward, however. Two moderately infected teeth were extracted. Six days later there was further improvement in the eye condition but without complete recovery.

A tentative diagnosis of chronic brucellosis was made on the basis of the history, positive intradermal test, and low phagocytic index (marked phagocytosis in 0 cells, moderate in 5, slight in 16; and none in 4). *Brucella abortus* vaccine was begun as a therapeutic test on September 27, 1941, and was followed by further improvement in the eye condition; circumcorneal injection persisted. There was exacerbation of the iritis on October 5, 1941, with severe pain and photophobia. This attack quieted down within a few days suggesting the possibility that the vaccine was having some favorable effect, especially because he reported feeling generally better. By October 16 the eye had returned to normal. However, on October 20, 1941, epigastric pain became more troublesome and persistent.

On October 25, 1941, his phagocytic index was found to be at a good level (14-6-5-0). Persistence of symptoms at this stage suggested two possibilities: (1) That the patient's illness was not attributable to his *Brucella* infection, or (2) that the infection was of such virulence, with possible undiscovered foci of infection, that a usually satisfactory degree of specific resistance was insufficient to allow recovery.

Subsequent progress was unsatisfactory in spite of intravenous *B. abortus* vaccine which was attended by typical reactions, with intensification of existing symptoms but without the usual improvement. The iritis flared up to a slight degree after the first dose of vaccine intravenously, then promptly improved and there was no recurrence. Gastrointestinal symptoms persisted although a second radiographic examination still showed no pathology.

Repeated electrocardiograms showed changes indicative of a toxic myocarditis; there was low voltage throughout and a tendency to left axis deviation.

On December 26, 1941, diagnosis was changed to undulant fever and he was brought before a board of medical survey which recommended that he be discharged from the naval service. On February 4, 1942, he was released from active duty. He returned to his home.

Follow-up.—His condition at home was reported on by members of his family who stated that there had been another attack of iritis shortly after returning home, that he had had a few attacks of vertigo, during one of which it was difficult for him to see, and that twice he had stumbled and fallen while going upstairs, for no apparent reason. For a period of 10 days during March 1942, he had complained of "quite severe headaches," usually lasting only a few minutes and usually accompanied by a very stiff neck.

For the following notes I am indebted to Dr. Frank Teachenor on whose service the patient was admitted on March 30, 1942, to the University of Kansas Hospital, to Dr. H. R. Wahl, Professor of Pathology, and to Dr. Melvin A. Rabe, resident physician at the hospital:

About 3 weeks prior to admission he had developed sharp pain in the left frontal region and about 4 days later some weakness of his right leg, with a tendency to limp. He had been unable to concentrate very well. On March 20 he had had a sudden hemiplegia, falling to the floor but not losing consciousness. Marked weakness of his right arm, leg, and right side of his face resulted.

Physical examination at the hospital revealed a rather thin, pale, white male who seemed to be definitely ill. The right pupil was slightly larger than the

left; both reacted to light. There was a questionable degree of choking of the left optic disc; the right disc was slightly abnormal but showed no measurable papilledema. Blood pressure was 130/90, pulse 50. There was marked facial weakness on the right side and marked weakness of the right leg and arm. Deep tendon reflexes were moderately increased on the right, with positive Babinski and ankle clonus.

Laboratory examinations showed no abnormalities of urine, blood count, serology, or chemistry. Agglutination with *Brucella abortus* was negative by tube test. Chest x-ray was negative. Radiographs of the skull showed evidence of increased intracranial pressure with some spreading of the suture lines. Spinal puncture on April 3 showed an initial pressure of 280 mm.; fluid was clear with cell counts of 33 white blood cells, 2 red cells, 85 percent lymphocytes, total protein 119; the second puncture showed a pressure of 230 mm., 32 white cells, and a total protein of 69.

There was slight improvement in speech and the hemiplegia fluctuated but showed no sign of clearing up. Operation and ventriculogram were twice postponed because the patient expressed himself as feeling better. However, on April 9 a burr hole was made just to the left of the midline at the coronal suture. As the ventricular cannula was passed toward the left lateral ventricle there was a lack of usual resistance to the needle. A biopsy cannula was then passed into the same region of the frontal lobe. The biopsy material consisted of a reddish brown, soft, cellular, granular tissue which grossly resembled either very soft rapidly malignant tumor tissue or encephalomalacia from a recent subcortical hemorrhage. Operation, therefore seeming futile, was discontinued. No hemorrhage occurred and the procedure seemed quite innocent. However, after an apparently normal postoperative period, at about 1 p. m. on the same day, he developed a sudden respiratory paralysis which continued while in a Drinker respirator; cardiac action continued but with no effort at voluntary respiration. He died about 4 p. m.

Histologic pathology was reported by Dr. H. R. Wahl as follows:

Section through the cerebellum shows nothing unusual except considerable distortion of the tissue. Section through the cerebellar cortex shows some increase in size of the perivascular and perineural spaces suggesting edema. Section through the pons shows spongy degeneration of the nerve tissue and a moderate perivascular infiltration with mononuclear leukocytes. Section through the choroid plexus shows dilatation and congestion of the blood vessels and a few small areas of calcification in the stroma. A number of the blood vessels contain a few polymorphonuclear leukocytes. Sections through the region of the left internal capsule show extensive acute and chronic inflammatory reaction with well-marked cufflike accumulations of monocytes and polymorphonuclear leukocytes in the perivascular spaces. Numerous large phagocytic mononuclear cells containing congested polymorphonuclear leukocytes are recognized in many areas. Polynuclear leukocytes are diffusely scattered through the nerve tissue in some sections. There is considerable spongy degeneration and softening of the nerve tissue associated with edema and in some areas considerable hemorrhage is present. Numerous compound granular corpuscles are seen in some fields and there are also many Nissl plump cells.

Dr. Wahl commented:

Death was obviously due to a rather severe acute and chronic form of encephalitis. Grossly the central portion of the cerebrum showed rather poorly defined areas of softening, and disintegration of the brain substance, giving a picture somewhat resembling either a severe form of encephalomalacia or that

of a spongioblastoma or other type of neoplasm. Microscopically there is a rather striking perivascular inflammatory reaction with more or less encephalomalacia, softening and disintegration of the cerebral substance. No tumor cells can be seen. Many large endothelial phagocytes are seen containing a variety of leukocytes, polymorphonuclear and mononuclear. It is interesting that polynuclear leukocytes are seen around many of the vessels and a number of them are scattered throughout the glial substance. There is nothing in the section to indicate the nature or source of this inflammatory process. It apparently is both of an acute and chronic form. It has an unusual amount of cerebral encephalomalacia associated with it. It is unfortunate that the autopsy was limited to examination of the cranial cavity; only a portion of the brain could be removed.

Dr. Wahl was of the opinion that the case should be reported under the title it bears.

COMMENT

The comment of the pathologist as to the acute as well as chronic nature of the pathologic findings in the cerebrum is of almost equal interest with the histologic findings. This patient had been ill for a period of 8 years with symptoms that were unexplainable in spite of numerous careful physical examinations and extensive laboratory study. It seems likely that central nervous system changes were occurring for some time before the onset of the acute process that resulted in hemiplegia and death from encephalitic encephalomalacia. Brucellosis is known to produce changes similar to those described in the pathologist's report in this case, as discussed by W. B. Sharp, R. N. DeJong and others. The clinical history suggested chronic brucellosis with acute exacerbations. In this instance a tentative diagnosis of brucellosis was made more than 6 months before death occurred but without benefit from the specific vaccine therapy thereafter initiated. Whether or not artificial fever therapy would have been of decided help or even productive of cure in this patient, as it often is in other forms of brucellosis that prove refractory to vaccine therapy, is a matter for speculation.



By "chronic" brucellosis is meant a case of insidious onset, long duration, and slow progress, attended by low-grade or no fever. Wherever indicated it might clarify terminology still further to speak of the acute or chronic phase or stage of the disease, rather than to apply the term to the illness itself. This is especially true since the acute and chronic phases may occur independently of each other and may follow each other in either order.

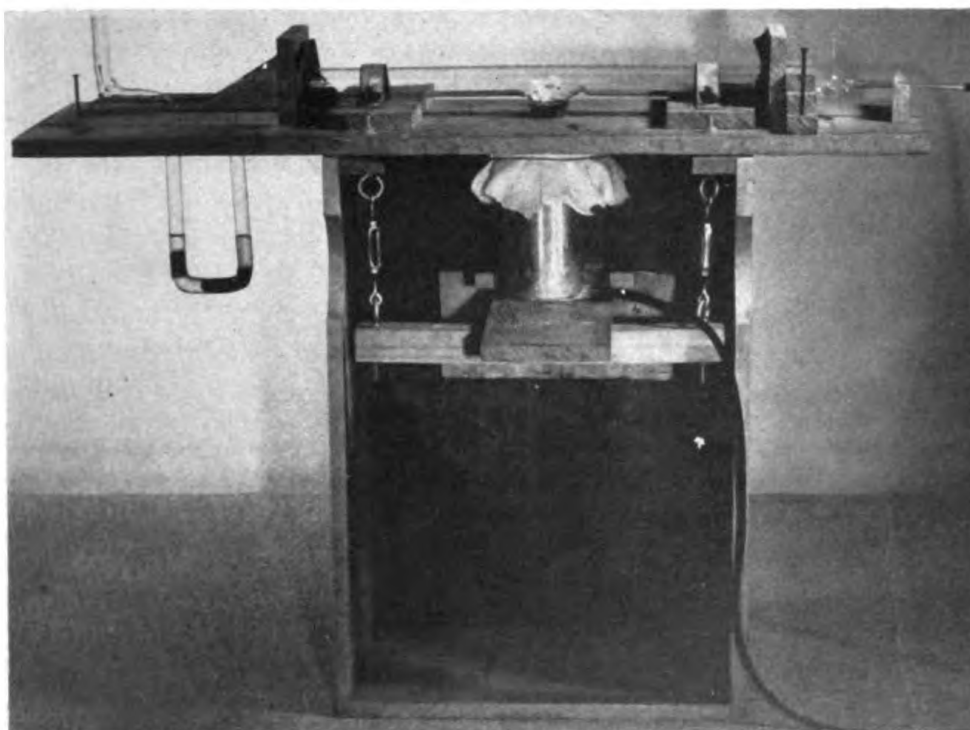
To define convalescence from acute brucellosis is still more difficult, for this stage may not be convalescence at all but a chronic interval between acute exacerbations.—Harris, H. J.: *Brucellosis (Undulant Fever); Clinical and Subclinical*. Paul B. Hoeber, Inc., New York, 1941.

MEDICAL AND SURGICAL DEVICES

AN APPARATUS FOR TESTING THE BACTERIAL FILTERING EFFICIENCY OF CLOTH OR SIMILAR MATERIAL ¹

By J. J. ENGELFRIED, Lieutenant, H-V(S), United States Naval Reserve, and F. W. FARRAR, Commander, Medical Corps, United States Navy

This apparatus was designed for the purpose of testing material used in the construction of face masks, acting as bacterial filters in preventing the spread of infection.

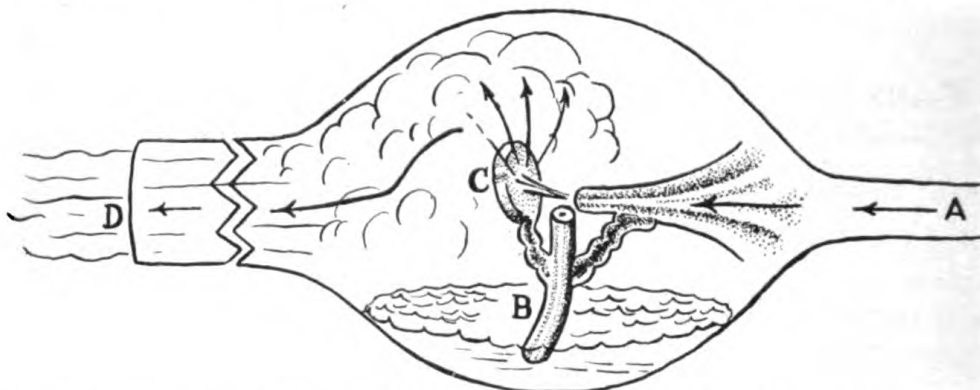


1. SHOWING THE APPARATUS READY FOR USE.

The apparatus shown in figure 1 consists of a sprayer capable of spraying a constant number of suspended bacteria into a glass tube. The organisms are then drawn by suction through the material to be tested and collected on an open Petri dish.

¹ Received for publication September 11, 1942.

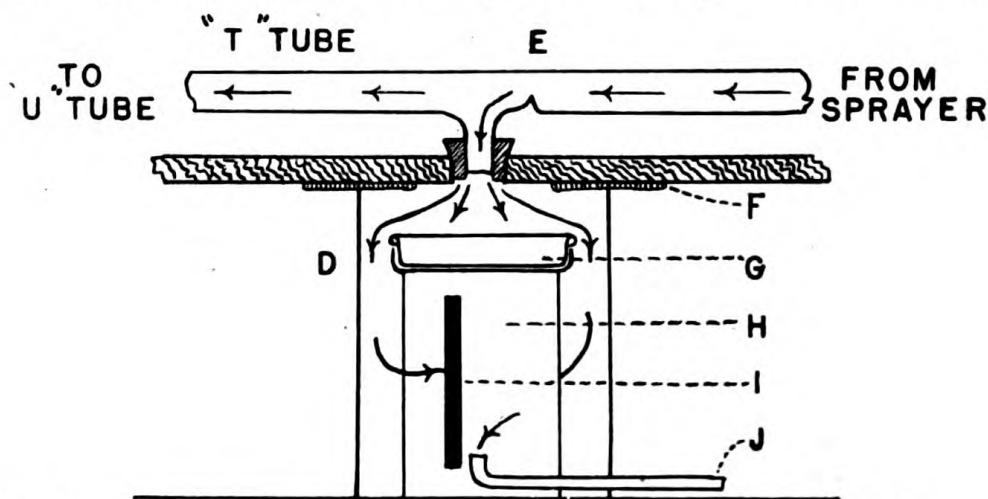
The most important part of the apparatus, and probably the most difficult to make, is the sprayer (fig. 2). The air opening (A) into the bulb of the sprayer must be small so that the air entering the bulb and passing over the capillary tube (B) has a high velocity, which will cause the fluid to rise in the capillary tube and spray it



2. SPRAYER FOR SPRAYING BACTERIA. A, AIR INLET (AIR PRESSURE); B, CAPILLARY TUBE (IMMERSED IN SUSPENSION OF BACTERIA); C, BAFFLE-PLATE; D, OUTLET (FOR VAPOR SPRAY).

against the baffle plate (C), which reflects the spray to the sides of the bulb (D) and forces a fine stream of vapor containing the bacteria out through the large outlet tube of the sprayer. The fluid used in the sprayer is a saline suspension of a 24-hour nutrient-agar culture of *Bacillus coli*, containing 10,000 organisms per cubic centimeter.

The outlet of the sprayer is inserted through an opening in a rubber diaphragm, made from an inner tube, into a glass T-tube (3.5 by 60 centimeters). The opposite opening of the T-tube is



3. TO ILLUSTRATE OPERATION OF APPARATUS. D, CAN (CONTAINING PETRI DISH); E, TRAP (TO PREVENT CONDENSATION FROM ENTERING OUTLET); F, RUBBER GASKET; G, EXPOSED PETRI DISH; H, CAN (ACTING AS HOLDER FOR PETRI DISH); I, AIR OUTLET (FOUR—ONLY ONE ILLUSTRATED); J, AIR OUTLET TO SUCTION PUMP.

covered with another rubber diaphragm, through which a U-tube containing steel wool saturated with cresol is inserted. This U-tube prevents the building-up of a pressure in the T-tube, as it allows the air under pressure to escape. The saturated steel wool traps the organisms, preventing them from contaminating the atmosphere. The other outlet of the T-tube enters a can containing the exposed Petri dish. Inside of can *D* (fig. 3) is a smaller inverted can having four slits (1 by 10 centimeters) for passage of air. There are spring clamps on top of the inverted can to hold an open Petri dish securely in place. Can *H* is soldered to can *D*. A metal tube *J* is connected through both cans. The open Petri dish should be centered approximately 5 centimeters beneath the outlet of the T-tube.

OPERATION OF APPARATUS

The suspension of *Bacillus coli* is pipetted into the sprayer, which is then inserted through the diaphragm in the T-tube. An opened Petri dish of Endo's medium is placed in the clamps on top of can *H*. The material to be tested is placed over the open top of can *D*. Can *D*, which rests on a hinged board acting as a lever, is fastened tightly against the rubber gasket by means of two turnbuckles. The air pressure attached to the sprayer is turned on. After 5 seconds the suction is opened to remove the air from can *D*. The negative pressure in can *D* pulls the bacteria laden air through the material to be tested. Approximately one-half of the bacteria passing through the apparatus will lodge on the open Petri dish. After 2 minutes of operation the pressure to the sprayer is closed; the suction is continued for 5 seconds.

TABLE 1.—Results obtained with the described apparatus

Layers of gauze tested	Series A ¹	Control (no gauze)	Series B ¹	Percent of bacteria removed	Layers of gauze tested	Series A ¹	Control (no gauze)	Series B ¹	Percent of bacteria removed
1		² (1) 376			8	(11) 31	(12) 366	(13) 16	94
2	(2) 169	(3) 388	(4) 185	54	10	(14) 17	(15) 364	(16) 21	95
4	(5) 114	(6) 380	(7) 113	70	12	(17) 23	(18) 392	(19) 23	94
6	(8) 71	(9) 352	(10) 72	80					

¹ Series A and B were the same type of gauze, but separate samples.

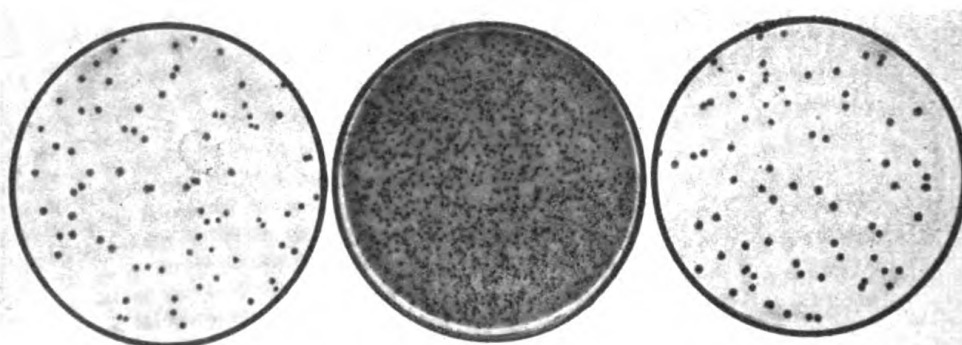
² Figures in parentheses represent the order in which the plates were exposed.

The Petri dish is covered and removed. A control plate is exposed with the same procedure except that there is no material over can *D*. Then another piece of the same material is tested. For each material tested there is a test plate, control plate, and a test plate. The average of the two test plate counts will give the number of bacteria passing through the material. The difference between this number and the control plate count will show the number of bacteria removed by the

material. (The plates are incubated for 24 hours, then refrigerated for 24 hours before counting.)

RESULTS

Figure 4 illustrates the results obtained with this apparatus. The test plates are on either side of the control and contain 83 and 87 colonies, respectively, while the control has approximately 1,400 colo-



TEST PLATE CONTROL PLATE TEST PLATE
4. SHOWING RESULTS OBTAINED WITH SIX LAYERS OF GAUZE (40 BY 44 STRAND).

nies. This material removed over 90 percent of the bacteria. This photograph also demonstrates that the colonies are evenly distributed over the surface of the media, and so distinct that the count can be accurately determined. Table 1 gives the results obtained with various numbers of layers of a gauze that were tested with this apparatus.

A STUDY OF SURGICAL MASKS ¹

By J. J. ENGELFRIED, Lieutenant, H-V(S), United States Naval Reserve, and
F. W. FARRAR, Commander, Medical Corps, United States Navy

It is very obvious that many of the face masks that are worn to prevent the spread of contagion are of little value. In many instances the structure of the mask makes it act as a deflector and not as a bacterial filter; while in other instances the material of the mask is not very efficient in removing the organisms present in the air. Therefore several types of cloth were tested with the apparatus described in the preceding article. These materials were tested before and after laundering. The effect of laundering on materials used for this purpose has been discussed by Rooks et al.²

¹ Received for publication September 11, 1942.

² Rooks, R.; Cralley, L. J.; and Barnes, M. E.: Hospital masks; their bacterial filtering efficiency and resistance to air flow; comparative study. Pub. Health Rep. 56: 1411-1419, July 11, 1941.

TABLE 1.—*Percentage of Bacillus coli removed by various materials before and after laundering*¹

Number of layers of material	Gauze-strands of thread per inch						Muslin		Flannel	
	12 x 20		40 x 44		60 x 64					
	Before	After	Before	After	Before	After	Before	After	Before	After
1.....							62	86	57	75
2.....			53	56			82	95	73	96
4.....	4	40	70	84	55	87	86	99.7	80	100
6.....			81	92	86	97				
8.....	18	86	94	93						
10.....			95	95						
12.....	65	91	94	99.5						
16.....	80	95								

¹ After materials were washed 20 times (in a washing machine using soap and rinsing in clear water. Cloth was thoroughly dry before being washed again).

Table 1 illustrates the effect laundering has on the material studied. The bacterial filtering efficiency of each was definitely increased. Table 1 also shows a comparison of these materials in their ability to remove bacteria from the air and the number of layers of each type required to give satisfactory results. As one would expect, the greater the number of strands of thread per square inch and the more layers of cloth used, the greater is the resulting efficiency of the mask. One layer of washed muslin between two layers of washed gauze (40 by 44 strands) removed 96 percent of the bacteria; while one layer of flannel between two layers of gauze removed 97 percent. Four layers of flannel removed all of the bacteria as shown by figure 5.

Starch also will increase the efficiency of a mask (table 2); however, this increase in efficiency of the cloth is not sufficient to compensate for the increase in resistance to air flow.

TABLE 2.—*The effect of starch on laundered gauze*

40 x 44 strands	Unstarched	Starched
	Percent	Percent
4 layers.....	84	87
6 layers.....	92	96

If a mask is worn for a long period of time its value as a filter will probably decrease. When a six-layer mask was tested in this apparatus for an extended time period, the percentage of bacteria removed during the test period of 2 minutes gradually decreased (table 3). An unused mask removed 88 percent of the bacteria in the air. After 3 hours of continual use it was capable of removing only 53 percent during the 2-minute test period (a control plate was exposed immediately after each test).

TABLE 3.—The effect of the continuous use of mask on its efficiency as a bacterial filter showing the percentage of *B. coli* removal

	Mask No. 1	Mask No. 2	Mask No. 3
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
During first 2 minutes..	89	88	86
After 10 minutes.....	81	80	79
After 15 minutes.....		78	69
After 30 minutes.....	71	76	74
After 45 minutes.....		72	
After 1 hour.....		72	72
After 1½ hours.....		62	62
After 2 hours.....		61	
After 2½ hours.....		63	
After 3 hours.....		53	

¹ At the termination of 1½ hours of use, this mask was washed-out in saline; a portion of this saline was plated and 100,000 *B. coli* were estimated to have been on the mask.

Six layers of gauze of 40 by 44 strands per inch will remove more than 90 percent of suspended *Bacillus coli* when tested by this apparatus. This test is probably much more severe than would be en-

CONSTRUCTION OF MASK

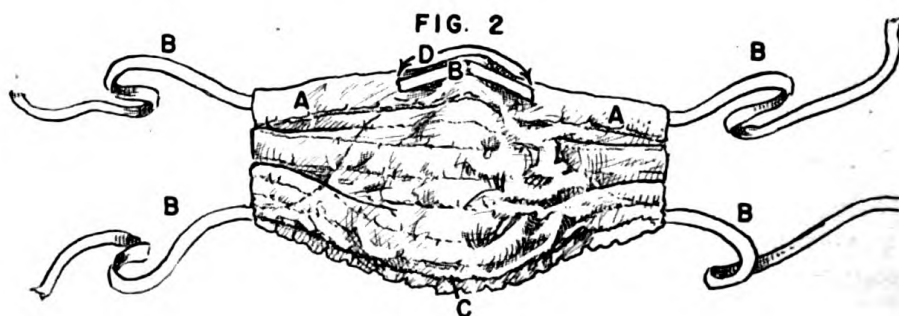
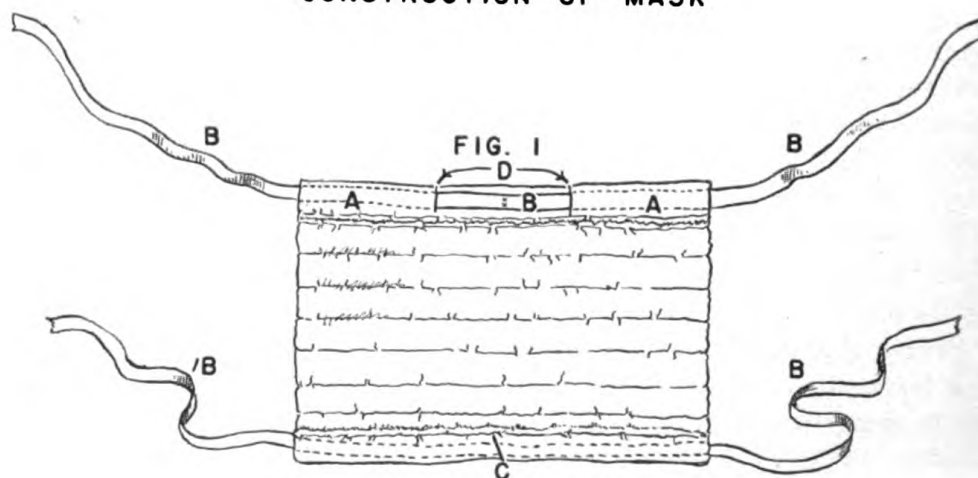


FIG. 3



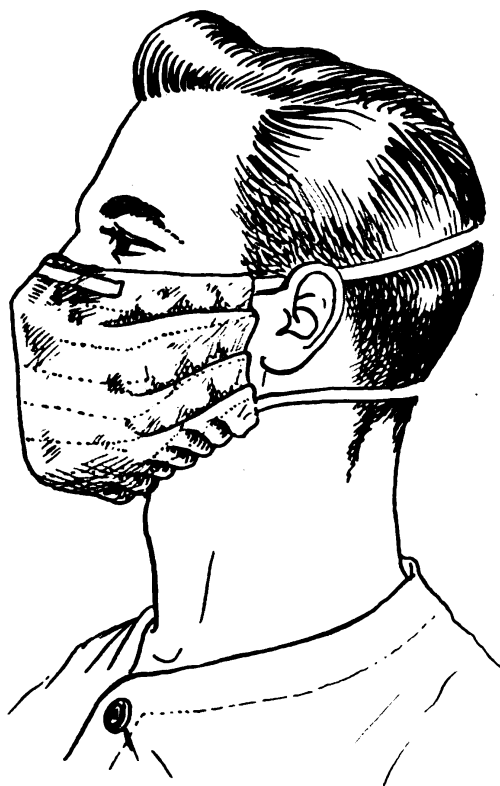
- A—MUSLIN FACING
- B—DRAW TAPES
- C—HEM (ON SAME SIDE AS FACING)
- D—PLACE FOR INSERTION OF METAL STRIP

countered when the mask is worn by an individual. Therefore this material when used for a surgical mask should give satisfactory performance.

STRUCTURE OF A SATISFACTORY MASK

Many of the masks in use today act mainly as a deflector and are not required to serve as a filter. The expired breath is deflected around the sides. Another serious criticism of some masks is the fact that condensaton of the moist, expired air will occur on glasses when worn.

Furthermore it must be remembered that any mask regardless of material or type of construction will create some degree of discomfort.

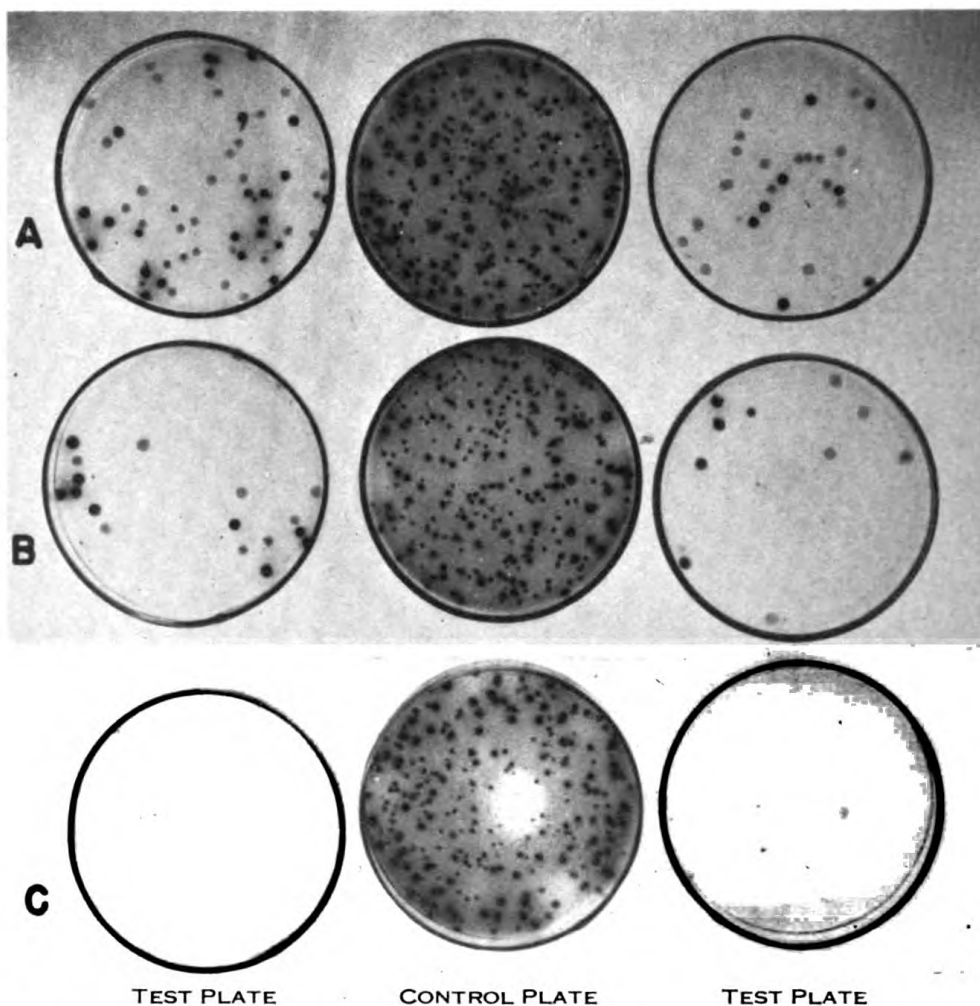


4. COMPLETED MASK.

With these criticisms under consideration an attempt was undertaken to devise a mask that would overcome these objections. Analysis of the results of the previous part of this study suggested that six layers of 40 by 44 strand gauze would be the most practical to use for the construction of a satisfactory type of mask. This mask will remove more than 90 percent of bacteria and will not cause too much discomfort to the wearer.

The gauze is cut to a size of 9 by 10.5 inches. The layers are stitched together as shown in figure 1. The bottom edge is folded

over to form a hem through which a tape is drawn. The tape is only stitched to the material in center as shown in figure 1. This allows the material to slide along the tape. The top edge was finished with a muslin facing. A tape is inserted as shown. This facing is cut to form a groove into which a metal strip can be inserted after the mask is completed. The sides are pleated to form the shape of the mask. A double stitching across the upper corners was made to hold the mask in shape (fig. 2).



5. A—SHOWING ONE LAYER OF FLANNEL REMOVED 75 PERCENT OF THE BACTERIA. B—TWO LAYERS OF FLANNEL REMOVED 96 PERCENT. C—FOUR LAYERS OF FLANNEL REMOVED ALL THE BACTERIA.

A metal strip shaped to fit the nose of the wearer was inserted in the upper facing. When worn, the facing on top edge of the mask should be outside of the mask. The tape which is sewed only to the outside piece of the facing does not interfere with the metal strip. The use of the metal strip is important to keep the mask fitting tightly over and on the sides of the nose. This prevents the

air being deflected along side of the nose, and also prevents fogging of glasses.

If the tapes are properly adjusted as shown in the figures, the mask will fit tightly and give satisfactory results (fig. 4).

ESTIMATION OF QUININE IN URINE ¹

INCLUDING A FIELD TEST FOR ESTABLISHING THE INGESTION OF QUININE IN MALARIAL PROPHYLAXIS

By A. J. GLAZKO, Ensign, H-V(S), United States Naval Reserve

A simple technic for the estimation of quinine in urine is desirable as a means of checking on the daily prophylactic use of the drug in malarious regions. An extensive survey of existing methods was made with the idea of establishing a reliable test for this purpose, suitable for use in the field. In the course of this work a quantitative method for the determination of quinine was also developed.

At least three general methods for the detection of quinine are available, depending upon: First, the well-known fluorescence of quinine in acid solution (1) (2); second, the formation of colored derivatives from oxidation products of quinine, of which the best known is the thalleioquin test (3); and, third, the formation of insoluble products with a large number of alkaloid precipitants, such as silicotungstic acid (4), Mayer's reagent (5), and the herapathite reaction with iodine (6). Most of these methods are not satisfactory for use with urine unless the quinine is first extracted with ether or chloroform from an ammoniacal solution. However, satisfactory results can be obtained directly on urine, using the double iodide of mercury (HgI_2K_2) as the precipitating agent. This reagent has been used for the detection of quinine by a number of investigators (7) (8); but the method described here incorporates a number of improvements, making the reagent more sensitive and suitable for quantitative work.

REAGENTS

1. *The double-iodide* is prepared by adding an excess of mercury (30 grams) to a solution of 22 grams of iodine and 30 grams of potassium iodide in 20 cc. of distilled water. The mixture is shaken vigorously until most of the brown color has disappeared (7 to 15 minutes); and then while still yellow, the solution is cooled rapidly under a running tap. The solution should be a light green color when cool. It is diluted to 400 cc. with distilled water and then decanted from the

¹ Received for publication September 9, 1942.

residual mercury. This solution will keep indefinitely. The reagent can be obtained on the market in granular form as Nessler's salt, which is convenient for immediate use in acid solution.

2. *Sulfuric acid*.—One part of the c. p. acid in 3 parts of water.

3. *Combined reagent*.—Equal volumes of the acid and double iodide solutions are mixed before use each day, so that only a single reagent is required for the test.

SIMPLIFIED FIELD TEST

To 5 cc. urine in a test tube add 5 drops of the acidic double-iodide reagent. In the presence of quinine and certain other cinchona alkaloids (9), a milky opalescence develops which is proportional to the amount of alkaloid present. Turbidity standards can be set up for comparison as an index of the quinine concentration. For field purposes, the urine specimens from men who did not take their quinine the night before will show only a faint turbidity.

The presence of more than 5 mg. percent albumin will give a flocculent precipitate with the reagent which is quite distinct from that due to quinine; while less than 5 mg. percent albumin produces a faint turbidity which may be confused with small amounts of quinine. This test produces a heavy milky opalescence, different from that of albumin, in urine taken the morning after a prophylactic dose of quinine. The presence of albumin is readily confirmed by boiling; the quinine iodo-mercurate dissolves, leaving a clear solution, while the albumin precipitate remains unchanged. If doubt should exist as to the presence of quinine together with a heavy albuminous precipitate, the sample may be boiled and filtered while hot. The albumin is removed and the milky opalescence of quinine iodo-mercurate reappears in the filtrate on cooling.

PHOTOMETRIC ESTIMATION OF QUININE IN URINE

The preceding method has been extended to the quantitative estimation of quinine in urine. A measured volume of urine (5 to 48 cc.) is placed in a 50-cc. volumetric flask and 2 cc. of the acidic double-iodide reagent is added with a pipette; the volume is then brought to 50 cc. with distilled water. The resulting concentration of quinine should be between 1 and 5 mg. percent for best results. The opalescence that develops is measured with a photonephelometer, using a yellow filter to minimize the variation in color of urine specimens. The reading is compared with that of standard quinine sulfate solutions made up in quinine-free urine, and treated with reagent in the same manner. A control for "zero-turbidity" is made by adding the reagent to quinine-free urine, which normally results in the appearance of a very slight opalescence. By using a series of stand-

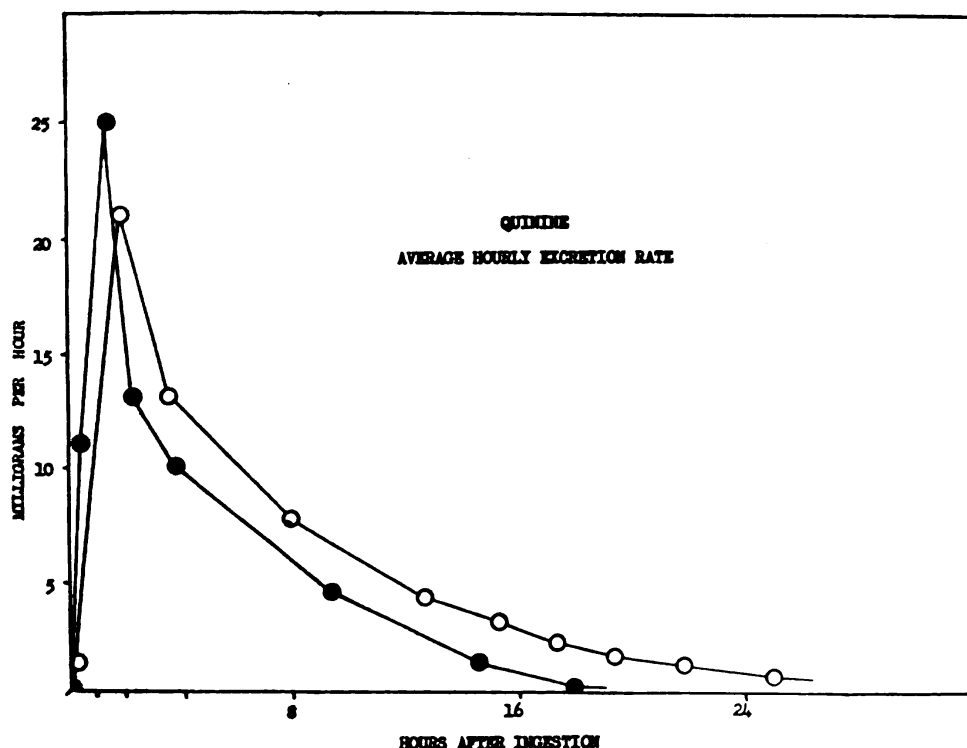
ards, the reading of the photometer may be translated directly into concentrations of quinine.

In order to develop maximum turbidity, it is essential that the pH of the urine be brought to about 2.0. It was found that the use of acetic acid did not yield the maximum turbidity. A simple method of obtaining the proper degree of acidity is to add sufficient sulfuric acid to give a strong acid reaction with congo-red paper. A moderate excess of acid does not alter the degree of turbidity.

The preceding method can be improved by extracting the quinine with ether at pH 9-10, evaporating the ether, redissolving the residue in acidulated water and conducting the test in a relatively pure aqueous solution. However, the technic presented above without extraction of the urine is sufficiently reliable for most clinical purposes.

EXCRETION OF QUININE

Quinine disappears from the blood stream with remarkable rapidity, only traces remaining a few minutes after intravenous injection (10) (11). Most of the quinine appears to be taken up by the reticulo-endothelial cells of the capillaries (9) (11), from which it is probably released slowly, and ultimately is destroyed by the liver, kidney and muscle tissue (11) or excreted in the urine. From 10 to 40 percent of the ingested or injected amount has been recovered from the urine, the figure varying even with repeated experiments on the



same individuals (2). Urinary excretion of quinine begins within a few minutes, reaches a peak in about 4 hours, and then decreases until there is only a trace excreted after 24 hours (2).

A number of experiments were carried out to demonstrate the excretion of quinine, using the nephelometric procedure. Nine grains of quinine sulfate were taken by mouth with the bladder empty, and then all the urine was collected in separate containers for at least 24 hours. The volume of each specimen was measured, the time of collection noted, and the concentration of quinine estimated. From this data it was possible to calculate the excretion of quinine in terms of average milligrams per hour for each collection period. The results of several such experiments on different individuals are presented in figure 1. It will be noted that the level of quinine excretion remains fairly high during the first 4 hours, and then falls off rapidly until a low level is reached after 18 hours. From these results it is evident that prophylactic doses of quinine taken at the evening meal will give a heavy turbidity with the double-iodide in urine collected the following morning; but with quinine ingested over 24 hours previously, the urine will give a low degree of turbidity.

SUMMARY

A simple test for quinine in urine has been described which requires a minimum of equipment. It is suitable for the rapid examination of urine in order to detect individuals who have not taken their prophylactic dose of quinine. A number of experiments were conducted to indicate the degree of turbidity which may be expected with urine collected at different intervals after the ingestion of quinine.

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AN INEXPENSIVE SOLUTION FOR SKIN STERILIZATION ¹

By M. O. BOUDRY, Lieutenant Commander, Medical Corps, United States Naval Reserve

The problem of maintaining a sufficient supply of skin sterilizing solution adequately to serve the increasing number of patients at sick call is not a minor one. Most commercial preparations are expensive and their use is restricted. Substitutes are not always satisfactory and are usually expensive. Novak and Hall ² have prepared a solution of considerable merit. They have tested it thoroughly and find that it adequately meets their nine requirements:

1. Its sterilizing efficiency is high.
2. It is noninjurious to the patient.
3. The time required for its action is minimized.
4. Its cost is very low.
5. It does not damage linen or instruments.
6. It is easy to apply.
7. It outlines the field covered.
8. It is nonirritating to operating-room personnel.
9. It is able to continue action during and after the operation.

This solution is successfully employed in the operating room of the Wisconsin General Hospital, Madison, Wis. It was there that I first became familiar with its merits, and when it became evident how economical the solution is to prepare in gallon lots, it appeared to me to be the ideal skin sterilizing solution for sickbay use.

The formula is as follows:

Alcohol 95 percent.....	525 cc.
Acetone	100 cc.
Water.....	375 cc.
Tricresol	5 cc.
Mercuric chloride	0.7 Gm.
Eosin "Y".....	0.6 Gm.
Acid fuchsin.....	0.08 Gm.

The solution is made in the following manner:

The mercuric chloride is first dissolved in the alcohol and then the acetone, eosin "Y," and acid fuchsin are added. To this solution the tricresol is added,

¹ Received for publication September 4, 1942.

² Novak, M., and Hall, Harry: A method for determining the efficiency of preoperative skin sterilization. *Surgery* 5: 560-566, April 1939.

followed finally by the addition of the water. The final solution is cloudy but it can be filtered to a clear solution. The question of the filter paper retaining too much of the dye was considered, and it was found that filtering was not necessary as the solution can be made brilliantly clear by the addition of 30 cc. of 10 percent hydrochloric acid.

As some of the items in this solution are not on the supply table they were purchased in small amounts on the open market, but even so the cost per gallon of the preparation is slightly less than one dollar.

At this activity we find the solution excellent for any type of skin sterilization and for the treatment of herpes simplex, infected blisters, and for "ringwormlike" lesions on the feet which are no doubt a combination of fungus and secondary infection from dirt and perspiration.

MERTHIOLATE-TANNIC ACID METHOD OF TREATING ABRASION WOUNDS ¹

By JAMES E. FULGHUM, Lieutenant Commander, Medical Corps, United States Naval Reserve

This report is prompted by the experience gained in the treatment of skin abrasions seen during several years of private practice. No reports have been found in which this exact type of treatment has been used. The treatment was originated for use in abrasive injuries in which the superficial or deeper layers of the skin have been rubbed or ground off, so often seen in traumatic wounds.

This type wound is difficult to treat by the usual methods, in that the serum and blood exuding from the wound are hard to control. The ordinary antiseptic and dry gauze dressings are unsatisfactory in that they usually stick to the coagulated serum and blood and when removed leave a raw and weeping area which heals slowly. Neither does this type wound do well when covered by petroleum-soaked gauze, as this keeps the wound moist and soft and forms a perfect field for the growth of bacteria. It is not advisable to leave these areas unprotected, especially if large areas are involved.

Tannic acid powder is readily soluble in tincture of merthiolate. To powdered tannic acid a small amount of tincture of merthiolate is added drop by drop, stirring constantly until a creamy paste is formed. Then with the addition of a few more drops of merthiolate the tannic acid goes into complete solution. This when applied to the skin dries quickly and leaves a glistening protective coating which is tough and resistant for several days.

¹ Received for publication August 18, 1942.

Upon admission the raw and oozing surfaces are gently swabbed to remove superficial dirt, debris, and excessive serum. The wound should be as dry as possible prior to the application of the medication to the surface. This is painted on in a thin coat which is allowed to dry. If thin areas are noted a second application is made over the first as soon as the primary application is dry. If blebs of serum form beneath, these may be punctured and drained and new medication painted over this area. The tannic acid acts as an astringent and almost immediately all oozing of blood and serum is checked. The merthiolate acts as an antiseptic and prevents infection.

Following the application there is formed a durable semi-transparent protective coating. In 3 to 5 days the outer edges may show evidence of some cracking and peeling. As epithelization progresses, usually very rapidly, the medication loosens and falls off.

The results were so encouraging that all other methods of treatment were abandoned in its favor. It was found that the period of treatment was cut approximately in half. There is no pain or discomfort to the applicant as is present with the usual antiseptics. Daily dressings are no longer necessary, as the coating will last from 5 to 7 days. It is however good practice to have the ambulatory patients come in every 2 or 3 days for inspection. No apparent damage was caused to the denuded areas by this method of treatment.

If complications should arise, such as infection, which is rare, and it is desired to remove the crust it is readily soluble and is easily removed.

Precautions should be taken not to make the solution too thin. Any solution not used should be kept in a tightly closed container to prevent hardening. It may be kept thus for weeks.

In conclusion, many cases of superficial, deep, large and small abraded wounds have been treated with the tannic acid-merthiolate mixture with good results and with no damage to the tissues. A durable protective coating is formed which requires no other dressing and over which the clothing may be worn or left open. The epithelium grows rapidly beneath and infection is rare.



Sulfadiazine concentrations in the body, like those of the other sulfonamides, vary directly with the degree of absorption from the intestines, and inversely, with the amount of acetylation and the speed of excretion. Consequently the level at which sulfadiazine will be maintained in the blood of a given individual by a certain dosage of the drug is predictable only within broad limits. In every case in which the drug is administered, we recommend that the free blood sulfadiazine level be determined within 12 to 24 hours of the beginning of

treatment, and further doses adjusted accordingly. Patients who are markedly dehydrated at the time of admission, or who have evidences of primary renal disease, or who are in congestive heart failure of any degree, should have their blood levels determined at least once per day, since these patients are subject to rapid accumulations of the sulfonamide drugs.

In view of the fact that the production of sulfonamides is still limited, and that isolated military groups may upon occasion have inadequate supplies of these drugs on hand, we merely wish to point out that under those circumstances patients with pneumococcic pneumonia may be treated with smaller doses than are usually recommended without apparently increasing the mortality rate.

SUMMARY AND CONCLUSIONS

1. Eighty-one unselected adults with typed pneumococcic pneumonia were treated with an initial dose of 2 gm. of sulfadiazine followed by 0.5 gm. every 4 hours until recovery was certain, or death ensued; while an alternate group of 79 patients was given 6 gm. initially, followed by 1 gm. every 4 hours.

2. There was no significant difference in mortality in the two groups, nor in the incidence of serious complications of the pneumonias.

3. In the patients receiving the higher doses of sulfadiazine, there was a slight tendency for the temperature to fall more rapidly than in the low-dose group; the duration of the hospital stay of the patients averaged 3.4 days less for the high-dose group; and the incidence of relapse, spread of the pneumonia to another lobe, and slow resolution was less than half as much in the high-dosage group as in the low-dosage group.

4. Toxic reactions from sulfadiazine were infrequent in both groups, and no more numerous in the high-dosage than in the low-dosage group.

5. It is concluded that, whereas higher doses of sulfadiazine are slightly more often followed by rapid recovery than the lower doses, and that there is less likelihood of relapse, spread of the pneumonia to another lobe, or of delayed resolution in the patients receiving the higher doses, nevertheless definitely smaller doses of the drug than are usually recommended can be used without fear of an increase in the mortality rate or of serious complications. This is significant in view of the fact that in the present emergency limitations of the supply of the sulfonamides may occur at times.—Dowling, H. F.; Hartman, C. R.; Feldman, H. A.; and Jenkins, F. A.: The comparative value of high and low doses of sulfadiazine in the treatment of pneumococcic pneumonia. *Am. J. Med. Sc.* 205: 197-203, Feb. 1943.

NOTES AND COMMENTS

CAN SHIPWRECK SURVIVORS UTILIZE SEA WATER?

It is doubtful whether any period in the world's history has so exposed man to the hazards of the open sea, adrift in small boats and on rafts as has the present. With this, of course, have been the pains and dangers of starvation and of thirst. The demands of the body for food are as nothing compared to its immediate insistent need for fluids. Thirty days without food can hardly be more damaging than 3 days without water.

The use of the abundance of tantalizing sea water to relieve this distress has always been considered beyond the pale, that that way madness lay. But of course periodically the optimist seeks to batter down this ages-old belief, to devise some way to get sea water into the system, if not by mouth, then by skin or by rectum.

Pearson¹ in a recent review of the subject of rectal administration summarized that salt-water enemas did not aid in preventing or curing the dehydration produced by deprivation of water, that they may cause more harm than good.

Bradish, Everhart, McCord and Witt² conducted experiments on an island near the mouth of the Mississippi. Subjects exposed themselves to wind and weather and reduced their water intake until the symptoms of water deprivation were becoming severe. In none was a diminution of thirst apparent after taking sea water instillations. Headache, weakness, and fogging of mental processes seemed to progress as the experiment continued.

They commented that "in a normal state of hydration the drinking of sea water will result in an extra loss of fluid with a subsequent dehydration. In a state of dehydration with the absorption of hypertonic salt water, there would be a tendency for sodium chloride to accumulate in the tissue spaces. The osmotic pressure of the extracellular tissue fluid being increased would remove fluid from the tissue cells themselves and from the blood stream. * * * We are con-

¹ Pearson, John S. : The inability of sea water to prevent dehydration. *Contact* 2 : Nov. 1, 1942.

² Bradish, R. F. ; Everhart, M. W. ; McCord, W. M. ; and Witt, W. J. Some physiologic aspects of the use of sea water to relieve dehydration. *J. A. M. A.* 120: 683-685, Oct. 31, 1942.

vinced that the use of sea water per se by this means would not only not prolong life but would actually hasten death.

"The only further line of investigation that appears to be open is conceivably the use of salt-free rations in conjunction with an amount of diluted sea water containing salt equal to that amount omitted from the ration."

This suggestion of a salt-free ration for boats and rafts for abandoning ships seems highly plausible, though entailing an additional factor of unpalatability.

The question of skin absorption of water is one which offers a field of investigation. Isolated reports are quoted of survivors who have been in better condition than their shipmates, due apparently to their having been continually or frequently immersed, hanging to the side of raft or boat due to lack of room aboard. Is water under these conditions absorbed through the sound skin; if so is the water absorbed without or with a diminution of its salt content?

AIR RAID INJURIES

Three years of British experience with air raids have significantly modified earlier concepts regarding the field casualty services.

Almost all raids occur at night; the victims are crushed under the debris of demolished buildings and are either dead or severely injured; less than a third are slightly injured and can be cared for at casualty stations; all the severely injured must go to a hospital; victims are invariably covered with dust and dirt which hangs in the air for hours. The conditions under which the rescue workers encounter the injured beneath the structural debris, the darkness, and the dust which always fills the air, the large proportion of dead and severely injured, and the urgent need for immediate hospitalization make it impossible to apply most peace time concepts of first aid.

Wounds are usually grossly contaminated and need only be covered with a shell dressing until the casualty reaches the hospital. Hemorrhage is usually controllable with a pressure dressing. The tourniquet is rarely employed. Burns are covered only with sterile gauze until the casualty arrives at the hospital. Tannic-acid jelly as a first-aid dressing for burns has been discarded because of the dirt which invariably contaminates the burned surface, because the jelly deteriorates rapidly, and, lastly, because tannic acid ignites in the presence of phosphorus when applied to burns caused by the explosion of phosphorus-oil bombs.

Traction splints are not used. An exception is made if the casualty must be transported a long distance over country roads. All that is done is to place the fractured extremity gently in alignment, bind it with triangular bandages to the uninjured leg or to an improvised splint, or apply a Thomas splint if one is on hand. Movement of the fragments can also be minimized by snug application of the blankets according to the Wanstead technic of blanketing and by the use of sand bags, which should always be carried in the ambulance.

Shock is treated at the incident by prompt administration of adequate doses of morphine (up to $\frac{1}{2}$ grain for adults), coramine, proper blanketing, administration of fluids, and the use of hot-water bottles during transportation to the hospital. The use of plasma or blood transfusion is deferred until arrival at the hospital; it is ordinarily quite impossible in the darkness, dirt, and confusion at the incident. (*Excerpts from Circular Letter of Dr. George Baehr to Regional Medical Officers, November 10, 1942.*)

NEW ANTIHAZE GOGGLE FOR SEAPLANE PILOTS

The problem of haze at sea has long concerned seaplane pilots charged with observation and patrol duty. At times haze may reduce visibility to the point that surface vessels only a short distance from the observer may escape detection. Likewise, surface glare may be so intense that the shadow of undersea vessels and the "feathering" of a periscope may not be seen unless the observer happens to be directly overhead. In addition, there are times when it is very difficult for the eye to establish a horizon line when flying even as low as 2,000 to 3,000 feet altitude.

Various devices and sun glasses have been used in an attempt to solve at least partially the problem outlined above. None employed to date have been markedly successful under all conditions of weather. In view of the present high degree of importance of improving seaplane pilots' visual acuity, experiments were conducted under operational conditions that led to the devising of a new type of antihaze goggle. This equipment has met with the approval of a great many seaplane pilots and observers who initially entered upon the experiment with much skepticism.

Under various conditions of cloudiness, temperature, wind velocity, altitude, turbidity of the water and surface glare seasoned pilots were tested aloft as to their ability to:

1. Distinguish horizon line.
2. See surface vessels and other objects outlined against the horizon.
3. See shadows of underwater objects.

A variety of lenses was placed before the subjects' eyes, using numerous combinations. It was felt that an entirely new type of visual aid would be necessitated to meet the need for a lens suitable for all-weather use.

The lens finally devised is made up as follows: There are three components, an anterior, middle, and posterior. The anterior lens is a 1.2-mm. thick sheet of noviol C shade glass. The middle lamina is a sheet of neutral polaroid material. The posterior component is a 1.2-mm. thick sheet of plano colorless crown glass. The three components are compressed accurately and tightly, with a convexity toward the front. The lenses were set in ordinary goggle frames. Side shields would increase the effectiveness of the device by shutting out lateral rays of light.

Although the haze problem is not completely solved by the use of the above-described lens, it is gratifying to note that experienced, skeptical observers now declare the new apparatus to be better for their purposes than any they have used previously. In actual use, the combination has proven to be "particularly good in picking up vessels on the surface and showing a horizon on hazy days" to quote the commanding officer of one seaplane squadron. Additionally, the new lens remarkably reduces glare from the surface of the water, enabling an observer to distinguish objects not otherwise visible due to the glare. The American Optical Co. is to be thanked for the aid its laboratories rendered. (*Lieutenant Commander M. P. S. Spearman (MC), USNR.*)

A MECHANICAL DIFFICULTY IN ADMINISTERING BLOOD PLASMA

Blood plasma is generally used as an emergency measure and hence frequently under unfavorable circumstances as regards handling and lighting. Such annoyance factors assume larger proportions when the element of speed is desirable, as is frequently the case.

One factor which has been frequently troublesome is mechanical in nature. This consists of inability to start the flow of the dissolved plasma through the tube. It is felt that this is, in all probability, due to small particles of undissolved plasma settling about the neck of the container and clogging the needle projecting into the solution. At any rate it may result in considerable annoyance and some loss of time.

It has been found that there is a very simple way of overcoming this problem. The air inlet tube is kinked and obstructed just medial to the filter. A syringe, preferably 20 cc., is equipped with a small, short needle and the plunger drawn out to the full position. The

needle is then introduced into the lumen of the rubber tube between the kinked spot and the container and air forced in by the syringe. Only a slight increase of pressure generally starts the flow promptly. Of course the technic is better if the needle and syringe are sterile, but in an emergency this is not absolutely necessary.

This technic does not present the danger of introducing undissolved material into the circulation as, after its use, the entire tube leading to the vein has to fill. At no time has clogging of the needle or observation of the solution indicated the presence of undissolved material at the distal end of the tube. (*Commander J. W. Kimbrough, (MC), USN.*)

THE PASSING OF SODIUM THIOSULFATE

The Council on Pharmacy and Chemistry of the American Medical Association has voted to omit all accepted preparations of sodium thiosulfate from New and Nonofficial Remedies and to revise the Useful Drugs statement of actions and uses to delete recommendations for use in mercurial and other forms of heavy metal poisoning and further to disparage its use in arsenical intoxication.

It is quite apparent from experimental evidence at least that sodium thiosulfate is of no value in the treatment of arsenical and other heavy metal intoxication. Even its use in the early stages of arsenical intoxication is very questionable. While it is true that the literature is replete with case reports of various arsenical intoxications, particularly dermatoses, in which the drug seemed to be of some worth, yet it must be remembered that certain of these cases would have responded to simple rest in bed and hygienic provisions. It is quite difficult to control such clinical material. *J. A. M. A., p. 124, Sept. 12, 1942.*)

BIOLOGICAL STAIN CRAYONS

Dr. Charles F. Elvers, Brady Building, Johns Hopkins, Baltimore, has devised a "biological stain crayon." The "crayon" is made by drilling out the lead in an ordinary paper covered pencil and filling with powdered stain compressed to solid consistency, and incorporating a glass rod in the other end. To use, a drop of water is placed on the slide, the "crayon" applied to drop and the solution then spread over the slide by means of the attached glass rod.

To date three stains are available: Plain methylene blue, methylene blue violet, and "polychrome 27". The last stains cytoplasm pink, nuclei blue, and organisms purple, and according to Dr. Elvers is especially fine for GC smears.

NARCOTIC PERMITS WHILE IN SERVICE

Physicians on active service with the fighting forces do not need narcotic permits. A private practitioner, within 30 days after receiving his orders to report for military duty, is expected to make known his changed status to the Collector of Internal Revenue. This is done by writing across the face of the regular renewal form (No. 678), "I am on active service with the (Army or Navy) at (name of station)." The form is then deposited in a special file so that the doctor will not be classed as delinquent. Upon his return to private practice he can get back his old permit number.

Discontinuance of his permit naturally bars the physician from prescribing narcotics for private patients and from having such drugs in his personal possession. Only in his official service capacity may narcotics be administered by him. (*Medical Economics*, Oct. 1942.)

COCCIDIOSIS—COCCIDIOIDOMYCOSIS

The following is quoted in entirety from *Radiology*:¹

An error in terminology which recently occurred in this Journal again focuses attention on the confusion of coccidiosis and coccidioidomycosis. Coccidiosis refers to an infection by one of the animal parasites included under the order Coccidia of the class Sporozoa; coccidioidomycosis is an infection caused by the fungus *Coccidioides immitis*.

Coccidia parasitize the epithelial cells of the intestines and livers of many hosts and are found in their feces. They are of considerable economic importance in poultry raising and other phases of animal industry. Coccidia commonly infect the intestines of chickens and other birds (*Eimeria avium*), the livers of rabbits (*Eimeria stiedae*), the intestines of dogs and cats (*Isospora bigemina*), the intestines of cattle, guinea pigs, mice, moles, and snakes. They have been claimed to infect the intestines and liver of man, but such infections as may occur in man are said to be very mild.

Coccidioides is an etymological derivative of Coccidia. When Rixford and Gilchrist published their account of "Two Cases of Protozoan (coccidioid) Infection of the Skin and Other Organs" in 1896, they believed that the etiological agent was an animal parasite, a sporozoon. They stated: "In order to emphasize the important analogies between our parasite and the coccidia, and at the same time indicate that we are not prepared at present to regard it as an unmistakable coccidium, we propose for it, in accordance with a sugges-

¹ *Radiology*: Vol. 39, No. 4, pp. 486-487, October 1942.

tion of Dr. Stiles, the generic name *Coccidioides*, and we designate the species as *Coccidioides immitis*." In 1900 Ophüls and Moffitt published the proof that the organism is a fungus and not an animal parasite. Five years later Ophüls stated: "As a name for the disease I should propose coccidioidal granuloma." Unfortunately, no other valid name was proposed for the fungus so that now mycologists have generally accepted the designation *Coccidioides*, thereby insuring confusion with coccidia in perpetuity.

Until Gifford and Dickson proved that so-called San Joaquin or valley fever was caused by *C. immitis*, coccidioidal granuloma was the only form of the infection which was recognized. When Dickson published his first paper on valley fever in 1937 he recognized the necessity of offering a name which would include those benign coccidioidal infections as well as the frequently fatal coccidioidal granuloma. His suggestion was "coccidioidomycosis." While "coccidiosis" is a tempting abbreviation of this cumbersome word, it will be apparent from this historical review that it is entirely erroneous. We must all suffer for the errors of our fathers. One other error we should avoid is that of making coccidioidal granuloma synonymous with coccidioidomycosis. Coccidioidomycosis includes not only the disseminated, progressive infection which Ophüls named coccidioidal granuloma, but also the usually benign initial coccidioidal infection with or without pulmonary symptoms or erythema nodosum. (*Charles E. Smith, M. D.*)

TETANUS TOXOID AND ANTITOXIN

"The type of immunity with the use of toxoid is active. Under normal conditions it is believed that the initial immunization plus a 'booster' in one year will protect for life, but we do not know because we have no human experience.

"If a man has received tetanus toxoid according to instructions, the rusty nail, etc., injuries can be ignored. If tetanus toxoid did not take care of this type of case the program never would have been adopted. Another point, avoid serum sickness and anaphylaxis, etc., by not using antitoxin. If the doctor wants to give anything after minor injuries in those who have been previously immunized, give a booster.

"Tetanus antitoxin is indicated only (a) for the treatment of clinical tetanus, (b) in individuals not previously immunized with tetanus toxoid, (c) when records are not available, and (d) when in doubt as to previously receiving toxoid. In an individual immunized

in accordance with our form letter,¹ the giving of antitoxin as prophylaxis is *never* indicated." (*Letter from Preventive Medicine in answer to personal query, December 18, 1942*).

ADMIRAL STITT RECEIVES FIRST GORGAS MEDAL

The first Gorgas Medal for "exceptionally meritorious services to preventive medicine for our armed forces" was awarded on December 15, 1942 to Rear Admiral Edward Rhodes Stitt, Medical Corps, U. S. Navy, retired, and two other military personages, Gen. Jefferson Randolph Kean and Gen. Frederick Fuller Russell.

The official citation for Admiral Stitt's award reads as follows:

For distinguished services as an officer who gave forty-two years of service to the Naval Medical Corps, including eight years as its Surgeon General; a distinguished scholar and an authority of international fame in tropical medicine, his extensive researches and voluminous writings in his chosen field have added materially to the sum of our knowledge of the maladies of the tropics and their prevention, and have contributed greatly to preventive medicine for our armed forces.

The medal is a beautiful work of numismatic art. It is of silver and bears the profile of General Gorgas. An honorarium of \$500 accompanies each award and is donated by John Wyeth & Brother. The selection of Admiral Stitt was unanimous.

The Association of Military Surgeons of the United States is the recipient of the gift, and its executive council bestows the medal when outstanding work in the field of preventive medicine for the armed forces makes such recognition appropriate.

¹ BuM&S Form Letter P2-3/EN(054) of August 5, 1941.



In recent years it has come to be recognized that there is no advantage either in prescribing massive doses of antimalarial drugs, or in administering such drugs over prolonged periods. The tendency of malaria cases to relapse is to a large extent independent of the dosage given, and of the duration of treatment. Short courses of treatment, frequently of only a week or even less in length, have therefore become the rule, and the daily dosage has also been reduced. The introduction of malaria therapy for the treatment of general paralytics has provided an unrivalled opportunity for research on this subject, and it is largely on the experience thus gained that modern ideas regarding the treatment of malaria are based.—Covell, G.: Note on economy in the use of antimalarial drugs. *Indian M. Gaz.* 77: 643-646, Nov. 1942.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

THE PRINCIPLES AND PRACTICE OF MEDICINE, Originally Written by *Sir William Osler, Bart., M. D., F. R. C. P., F. R. S.*, Designed for the Use of Practitioners and Students of Medicine, by *Henry A. Christian, A. M., M. D., LL. D., Hon. So. D., F. R. C. P. (Can.), F. A. C. P., Hersey Professor of the Theory and Practice of Physic, Emeritus, Harvard University.* Fourteenth edition, 1,475 pages. D. Appleton-Century Co., Inc., New York, publishers, 1942. Price \$9.50.

This reviewer is glad of the chance to pay tribute to a beloved volume. He fell under its thrall while in its third edition. That old, much handled treasure, has gone to the happy hunting ground of such books, but at hand is a well-preserved fourth. The preface was still signed by "William Osler," probably the spade work his, but thanks were given to "my colleague, Dr. W. H. Welch; my associates and assistants, Drs. Thayer, Fletcher, McCrae, T. R. Brown, L. P. Hamburger, and Rufus Cole, for much important aid; Dr. Simon Flexner, now of the University of Pennsylvania, for information upon the forms of dysentery; Drs. W. G. McCallum and E. L. Opie, for notes from the Pathological Department."

The fourth opened with a tremendous monograph on typhoid. The barbarous hydrotherapy of that day occupied, of course, most of the pages on treatment. Lobar pneumonia's unforgettable lines still survive in the new edition. "Captain of the Men of Death * * *. Pneumonia may well be called the friend of the aged. Taken off by it in an acute, short, not often painful illness, the old man escapes the 'cold gradations of decay'." And on syphilis "Certainly it is better, as St. Paul says, to marry than to burn, but if the former is not feasible there are other altars than those of Venus upon which a young man may light fires. * * * If the offender bore the

cross alone, I would say, forbear; but the physician behind the scenes knows * * * the havoc among innocent mothers and helpless infants."

It was this that was half the holding charm of Osler—the greatest internist of his day, the wielder of a facile and delightful pen. When the mantle fell on a collaborator and successor, Thomas McCrae well became it. This reviewer remembers also the pleasure of ward rounds at Hopkins with McCrae, his scholarly and polished presentation of a case. But the present reviser, Henry A. Christian, shoulders his way as an equal among that great group of early Hopkins giants which was led by Osler. The writer has also had the joy of the Christian touch in rounds at Peter Bent Brigham, and believes that no living man is better qualified professionally and culturally for the perpetuation of the Osler classic. This edition is the original Osler concept molded to present-day knowledge. No remnant of obsolescence is apparent. Montreal General, McGill, Pennsylvania, Hopkins, and Oxford conceived; Jefferson, Peter Bent Brigham, and Harvard have culled and remodeled and refined with successive editions.

The new volume is a credit to the publishers. One of McCrae's editions, that of 1927, was marred by an inexcusable number of typographical errors. It is to be hoped that closer reading of this will find such a criticism no longer applicable.

Features of this fourteenth 1942 edition are: (1) Latest accepted methods of treatment, especially chemotherapy, presented in greater detail and conveniently placed with the discussion of each disease; (2) Increased emphasis on the functional aspects of medicine; (3) Subjects rearranged into more logical sequence based on prevalence and present day importance of each disease; (4) Epidemiology properly stressed; (5) Necessary pediatric considerations included; (6) Tropical and parasitic diseases allotted increased space as required under modern conditions; (7) Diagnosis simplified by the finest clinical descriptions of disease in the English language; (8) Bibliographic data introduced for the first time with references largely to accessible sources, many 1942; (9) Newly identified diseases discussed; (10) A remade index, complete to the last detail.

This reviewer has always believed that a one-author, or one-editor textbook is a more rounded product than one that is the contribution of many minds and pens, no matter how exalted or talented these collaborators might be. Naturally the one would tend to the least of overlapping or of omission, faults almost unavoidable in the other. For the undergraduate whose textbook of medicine must, or at least should, become as his bible, Osler provides a fluidity and continuity giving ease of reading, and at the same time for the office shelves its 1,475 pages make it broad enough for reference.

May the fiftieth anniversary version become as delightful a memory in the graying years of today's graduates, as its earliest progenitors have been to their fathers.

SURGERY OF MODERN WARFARE, Volumes I and II, edited by *Hamilton Bailey, F. R. C. S., Surgeon, Royal Northern Hospital, London*; compiled by 72 contributors. Second edition (complete in two volumes). 1,028 pages with 919 illustrations. The Williams & Wilkins Co., Baltimore, Md., publishers, 1942. Price \$20 per set.

The second edition of this progressive work is a decided step forward from that of the preceding year. Naturally, military surgery in this chaotic period is developing rapidly. Excellent and well-illustrated chapters keep pace with the latest in blood banking and transfusion technic, shock and its treatment, blast and crush injuries, a sketchy reference to immersion blast injury, the latest word on burn treatment, including envelope treatment, triple dyes, and the sulfonamides.

War wounds of all description are covered copiously, as are amputations, emergency transportation, casualty hospital and first-aid post organization.

"Surgery of Modern Warfare" has been written by a team which can claim to represent British Surgery. By this is meant that the members belong neither to a particular school nor are they drawn from any one medical service. Reflected in its pages is teaching from London, the Provinces, Scotland, Wales and Ireland, and experience culled from the Navy, Army, Air Force and Emergency Medical Service.

Some of the contributors base their views on observations made during the present conflict; others record ripe experience amassed during the eventful years 1914-18; not a few are able to contrast and compare the surgery of both campaigns.

So it comes about that into this surgical cauldron have been poured the fruits of much experience, and ingredients which should be palatable to the war surgeon. In order to aid quick assimilation at a time when close study is difficult, the principles enunciated have been illustrated freely.

This is an indispensable textbook for the surgeon who has to deal with injuries associated with warfare. It is assumed that he is trained, but not necessarily highly experienced, in civil general surgery, and that he requires guidance on the special technic and management of the wounded.

OPHTHALMOLOGY AND OTOLARYNGOLOGY, Military Surgical Manuals, Volume II, prepared and edited by the *Subcommittee on Ophthalmology and Otolaryngology of the Committee on Surgery of the Division of Medical Sciences of the National Research Council*. 331 pages, 124 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$4.

This volume is poorly described by its title. Here, even more than in its companion pieces one plunges right into a war status. Elementals

are skipped. The early care of ocular and facial wounds in wartime will probably devolve on surgeons and internists, in the great majority of cases having had little practice in such lines. Only the simplest treatments and procedures are outlined, but these clearly and to the point. Special instruments and appliances are not discussed, the presumption being accepted that only general surgical equipment will be available. It is assumed that specialized tools will be found at bases where there will be suitable consultants and where the usual textbooks will be available.

Otolaryngology hardly justly describes that half of the volume which gives 44 pages and 36 halftones and linecuts to primary treatment of gunshot wounds of the face, plus excellent separate chapters on the ear, the temporal bone, labyrinth, tests of hearing, malingerer, petrositis, the ear in aviation, oral and labial reeducation (possibly hardly called for in this emergency compend), nose, throat, and chemotherapy.

This is an excellent volume. It is difficult to consider any criticism as applicable, remembering always that the objective is conciseness and portability; an emergency compend, not a textbook.

ABDOMINAL AND GENITO-URINARY INJURIES, Military Surgical Manuals, Volume III, prepared under the auspices of the *Committee on Surgery of the Division of Medical Sciences of the National Research Council*. 243 pages, 79 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$3.

This is a most excellent, almost pocket-size compend of technic in abdominal and urologic surgery. The viewpoint is of course largely directed toward casualties of war. The approach is well planned in classification and general consideration, symptoms, examination, pre-operative care, and then localized surgical procedure. Illustrations are clear and fairly copious; it is a pity space did not allow more. In fact the brevity of the entire volume almost belies the claim "Abdominal" in its title, with only 45 pages on specific procedure in that region, and these pages including 27 large illustrations.

The genito-urinary half of the volume merits considerably higher acclaim both in coverage and in illustrations. Here also the purview is entirely that of war injuries, divided into "Diagnosis of War Injuries of the Genito-Urinary Tract in General," "Injuries of the Kidney and Ureter," "War Injuries of the Bladder," "The Neurogenic Bladder," and injuries of the genital organs.

The volume closes with a short chapter of "Do's and Don't's," a sapient little guide, as among the "Do's"—"perform nephrectomy almost always for gunshot wound involving one kidney"; among the "Don't"—"don't ever perform nephrectomy for any reason without ascertaining the presence of an adequate kidney on the other side."

This is an excellent volume for the purpose for which it is intended, a small emergency guide for major operative procedures, possible of

pocket carriage where the bulky textbook of surgery must be left behind.

FUNDAMENTALS OF PSYCHIATRY, by *Edward A. Strecker, M. D., Sc. D., F. A. C. P., Professor of Psychiatry and Chairman of the Department, Undergraduate School of Medicine, University of Pennsylvania.* 201 pages with 15 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.

In this volume the distinguished clinician and Salmon lecturer presents in compact form a handbook of the fundamentals of psychiatry. More physicians are familiar with his other works, particularly his textbook on clinical psychiatry. His purpose in presenting this book is to enable the reader to "obtain with a minimum of time a workable picture of the field of psychiatry, knowledge which constantly can be interwoven with his work."

The book stresses the close tie-up between internal medicine and psychiatry, and is completely up-to-date in its discussion and evaluation of the newer methods of treatment. It treats with the problem of the examination of mental patients, with symptoms, etiology, and with classification and treatment of the psychoses. A chapter on the treatment of military neuropsychiatric disabilities is included, and is well summarized in an outline form suitable for ready reference. The author speaks with authority when discussing military psychiatry because of his combat experience and the fact that he was chosen to write the psychiatric section of the Technical Guides to Therapy for Medical Officers in the Army. This chapter will be of invaluable assistance to the medical officer pressed for time and faced with psychiatric problems. The chapter on the psychiatry of war could be read with profit by everyone. The conventional outlines and discussion of the psychoses and neuroses are clear and concise; not only are they described and classified, but the mechanisms which underlie their formation are explained.

The contents are well organized and the book could be readily used for a refresher course in psychiatry. The work is compact, concise, clear, well-written, and readable. The book is well indexed and the illustrations are easily understood. This volume should be on the "must" list of physicians in the armed forces, no matter what their specialty.

ANATOMY OF THE HUMAN BODY, by *Henry Gray, F. R. S., Late Fellow of the Royal College of Surgeons; Lecturer on Anatomy at St. George's Hospital Medical School, London;* edited by *Warren H. Lewis, B. S., M. D., Member The Wistar Institute of Anatomy and Biology, Philadelphia, Pa. and six associate editors.* Twenty-fourth edition, thoroughly revised, 1,428 pages with 1,256 engravings. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$12.

Gray's twenty-fourth American Edition hardly needs any introduction. It is as though with the curtain rising on the battlements

of Elsinore one were to urge upon the audience the merits of the coming play. Tried through almost a century, Gray has stood the test of years, keeping pace always with investigative advance. Anatomy would seem, of the basic grounds of medicine, to be the nearest to a completely worked-out mine, yet always some grains or nuggets are being unearthed.

In revising, rewriting, and making additions, the editors have woven into the text the latest information in their fields, yet have retained the familiar arrangement of chapters and subject matter that has characterized the book for so many years. It has seemed desirable to retain this general arrangement because the book is designed not only as a text for students but also as a reference book for those older men who became familiar with it during their early years.

Paper, type, illustrations and binding are a delight. The reviewer can find no word of criticism of contents, context, or format. There is no better.

SYNOPSIS OF PATHOLOGY, by W. A. D. Anderson, M. A., M. D., Assistant Professor of Pathology, St. Louis University School of Medicine; Pathologist, St. Mary's Group of Hospitals. 661 pages with 294 illustrations and 17 color plates. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$6.

This is a handy-size, well-bound volume of 661 pages, printed in clear type on glossy paper. The author states that he has attempted to meet the need of medical and dental students and of clinicians for a volume to fill the gap between the elementary manuals and the larger textbooks of pathology.

The earlier chapters discuss inflammation, regeneration and similar topics, and are followed by five short chapters on the bacterial, viral, spirochetal, protozoal, and helminthic infections. The magnitude of the author's task of compression is illustrated by the fact that tuberculosis is disposed of in 20 pages of which less than half are text. After chapters on poisons, vitamin deficiencies and disturbances of growth, the remainder of the book (14 chapters) is devoted to pathology as related to the anatomical system.

Each subject is covered concisely and accurately, and the views expressed seem to be sound and modern, as, for example, in the chapter on tuberculosis. The references are up-to-date and not so numerous as to be confusing to the student.

Excellent features of the book are the color plates, 17 in number, and the abundance of illustrations, microphotographs, and tables. The author is to be congratulated upon his access to the photographic collection of Dr. H. C. Schmeisser. The index of 23 pages makes the contents of the book quickly available and reference finding is made speedy by setting paragraph headings and key words in bold type.

This book will probably find a welcome from students. Undoubtedly many clinicians would profit by using it regularly. However, in point of actual practice, one who has the interest and energy to look up some topic in pathology, or who, in the author's words, wishes to maintain familiarity with the foundation sciences of medical practice, would ordinarily be dissatisfied with the brevity of this book. Its price approaches too nearly that of the standard textbooks of the day to be attractive to such a clinician.

If the discovery of a typographical error is the hallmark of a genuine review, the reviewer was fortunate to find two in this well-edited book. Ziehl-Neelsen is misspelled in table 1, page 38, and vitamin in the index is out of its natural alphabetical order.

THE CARE OF THE AGED (Geriatrics), by *Malford W. Thewlis, M. D., Attending Specialist, General Medicine, United States Public Health Hospitals, New York City*. Fourth edition, thoroughly revised; 589 pages with 50 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$7.

Geriatrics—the science of the care of the aged, has come rapidly to the fore as a separate and distinct specialty. The 1940 census indicates that there are approximately 9,000,000 persons over 65 years of age in this country at the present time. Due to the increased life expectancy and the increased life expansion made possible by advances in medical science, it bids fair to assume even greater proportions.

Thewlis is an early worker in this field, and one of the few recognized authorities on the subject. The fourth edition of his book has been enlarged, and additional material on subjects such as respiratory infections, liver function, blood transfusions, and chemotherapy have been added. The book is divided into five sections; general considerations are discussed in section 1, miscellaneous medical problems in section 2, specific infections in section 3, noninfectious diseases in section 4, and section 5 contains a discussion of pathological conditions in old age. Additional special chapters have been contributed by other qualified workers. Every angle of the medical and surgical handling of the problem and many little hints as to the general care and treatment of patients in the older age group are included.

The psychological problem which accompanies advancing years and which often spells the difference between success and failure in the treatment of old people, is briefly and adequately discussed. This is important because many times the doctors who are alert and detect oncoming senile and arteriosclerotic changes can save the family and the patient from grief and disgrace.

The chapter on therapeutics is noteworthy. The author comments on the fact that overenthusiastic treatment, whether with drugs, diet, or exercise, will tend to change the patient to the status of "autopsy

material." The action of drugs, alcohol, and physiotherapy in the senescent patient is considered. Another chapter discusses the nursing care which is also quite important. The volume is well written and the frequent interpolations of historical and other pertinent comment make it easy to read. The typography is good and the book is well indexed. Perhaps the only thing that could be hoped for is that the new science will not introduce a new set of terms. An instance of what is meant is the appearance of the word "gerocomia" in chapter six. The word "hygiene" in this case would suffice very well.

The book offers little to the physician in active military service, but in view of the fact that our war problem places grave responsibilities on the older age group, civilian doctors who are charged with their care would do well to acquaint themselves with this rather excellent volume.

AN ATLAS OF HUMAN ANATOMY, For Students and Physicians, Volumes I and II, by *Carl Toldt, M. D.*; assisted by *Professor Alois Dalla Rosa, M. D.*; adapted to English and American and international terminology by *M. Eden Paul, M. D., Brux., M. R. C. S., L. R. C. P.* Second edition, 956 pages, 72 page index for complete set in each volume. The Macmillan Co., New York, publishers, reprinted in 1941. Price \$12 per set.

This two-volume Atlas of Human Anatomy, as stated, is expertly designed for both student and physician. The Atlas contains sections on regions of the human body, osteology, arthrology, myology, splanchnology, angiology, neurology and the organs of the senses. Excellent appendices are present for the sections on splanchnology and neurology. The sections on osteology, arthrology and neurology are particularly good.

The Atlas is made up of 1,505 illustrations, colored and black and white. The nomenclature employed is the most modern adapted to the English and American and international terminology. A general index is present in both volumes making the Atlas particularly useable.

The Atlas is the second edition and has been thoroughly revised and enlarged. The size of the volumes and the nonglossy paper makes for easy study. The volumes are well bound and durable. This Atlas could well form a unit in the library of any teaching institution or physician.

THE AUTONOMIC NERVOUS SYSTEM, Anatomy, Physiology, and Surgical Application. by *James C. White, M. D., Assistant Professor and Tutor in Surgery, Harvard Medical School*; and *Reginald H. Smithwick, M. D., Instructor in Surgery, Harvard Medical School.* Second edition, 469 pages. The Macmillan Co., New York, publishers, 1941. Price \$6.75.

During the past few years there has been a progressive realization among physicians that the autonomic nervous system plays an im-

portant part in the cause and treatment of various diseases. For this reason the physiologists have been stimulated to investigate this portion of our nervous system and have discovered many pertinent facts which have a clinical bearing.

During the investigation of any subject there arises a confusion of ideas, and a great deal of misinformation is likely to be circulated based upon erroneous conclusions, and the second edition of this book brings to the doctor an excellent explanation and delineation of facts which tend to clarify what is known about the subject today.

The book is divided into three parts, the first having to do with the historical development of our knowledge on the subject; the anatomy, general physiology, action of drugs and hormones. The second part deals with diseases and disorders of the various parts of the body and the third part with the types of operation which are accepted today in the treatment of various diseases.

If one were seeking a single volume containing a review of the subject with a complete and impartial text and adequate bibliography, this book should be added to his bookshelf.

MEDICAL PROGRESS ANNUAL, Volume III, 1942, A Series of 52 Reports on The Recent Accepted Advances in Diagnosis and Treatment Published During 1941 in The New England Journal of Medicine; Robert N. Nye, M. D., Managing Editor, 678 pages. Charles C. Thomas, Springfield, Ill., publisher, 1942. Price \$5.

This remarkably informative book is a compilation of the 52 reviews published, one in each issue of The New England Journal of Medicine during 1941. It is a series of short monographs on the various subjects discussed rather than a group of "recent advance" articles. Ranging alphabetically from allergy to war medicine, the book includes such unusual subjects as arteritis, hypothermia, and ovulation.

The general practitioner will find this book a pleasant and painless way of keeping up with recent medical progress. Most specialists will find something new in their own fields, and will get valuable instruction about new work in other specialties. For the doctor in the Navy and the Army there are good articles on aviation medicine and war medicine, and also much in the chapters on bacteriology, blood chemistry, blood transfusions, chemotherapy, and other subjects that deal with the role of science and medicine in war.

Although the articles are written by many different authors, the style is almost uniformly vigorous and stimulating. The editor, Dr. Robert N. Nye, is to be congratulated for this, as well as for the general excellence of the book.

TREATMENT IN GENERAL PRACTICE, by *Harry Beckman, M. D., Professor of Pharmacology, Marquette University School of Medicine, Milwaukee, Wisconsin.* 1,015 pages, fourth edition, thoroughly revised. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$10.

Dr. Beckman begins the preface to this fourth edition by complaining that "we have been so superbly educating our young men" that he has had a good deal of difficulty in keeping his book abreast of the times. He has, however, taken great pains to do so and among the new features listed in the fourth edition are acute infectious hepatitis, Australian disease, Haverhill fever, histoplasmosis, strontium poisoning, sulfonamide toxicities, and many others.

The general form of the book is unchanged and retained in it are the many excellent features which have made this one of the first books a busy doctor reaches for when confronted with a problem of treatment.

SHOCK, Its Dynamics, Occurrence and Management, by *Virgil H. Moon, A. B., M. Sc., M. D., Professor of Pathology, Jefferson Medical College, Philadelphia.* 324 pages, illustrated with 36 engravings. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$1.50.

The casualties of conflict practically all reach the medical officer with one initial stage in common, that of shock. Whether burn or blast or gunshot the first problem is the treatment of shock. And yet the actual dynamics of this universal feature are not known. Anoxia, hyperactivity of the sympatho-adrenal system, vasomotor exhaustion, decreased alkaline reserve, depletion of tissue fluids, failure of intramuscular pressure, may any and all be the causative factors. The first half of this volume is devoted to vascular dynamics of shock, and it would be difficult to find any more compact and lucid discussion of this.

The second and lesser part is the prevention, recognition and management of shock. Various chapters cover all phases with short summaries concluding each. The mechanics and rationale of fluid replacement, blood, plasma or serum are covered, and the technic of marrow infusions where veins cannot be easily entered is described. A 437-item bibliography concludes an excellent treatise.

SYNOPSIS OF BLOOD DISEASES, by *A. Pincus, M. D., M. R. C. P., Physician, St. Mary's Hospital for Women and Children, London.* 120 pages. The Blakiston Co., Philadelphia, Pa., publishers, 1942. Price \$2.75.

This is another almost pocket-size volume, one of the trend toward small, compact compends suitable for field, expeditionary, or small-craft use. It covers the purely practical aspects of hematology. Concise, intelligible descriptions of each disease are presented, the various synonyms are listed, symptoms are carefully outlined, and a detailed,

up-to-date discussion of treatment is included. No attempt has been made to go into enough detail to satisfy the hematologist or clinical pathologist.

The few color plates are excellent, there is an excellent glossary which is practically a dictionary, and appended are unusually understandable tables giving physical characteristics of red and white cells in their various stages of morphology. Twenty-six varieties of leukocytic forms are differentiated.

THE SURGERY OF PANCREATIC TUMORS, by *Alexander Brunschwig, M. S., M. D., F. A. C. S., Professor of Surgery, University of Chicago.* 421 pages with 123 text illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$7.50.

Pancreatic lesions offer one of the most difficult problems in abdominal surgery. This is particularly true in lesions involving the head and body of the pancreas.

This text of 397 pages is most comprehensive in its covering of the field of pancreatic tumors, both malignant and benign, including those of the ampulla of Vater. The chapters on the anatomy, embryology and physiology, together with the chapter devoted to experimental pancreatic surgery, give an excellent background for the modern surgical methods used in the treatment of the various lesions involving the pancreas.

Considerable literature has accumulated on the subject of pancreatic cysts and reports of successful surgical treatment of these lesions go back over a century but it is only very recently that successful surgical excision of malignant lesions of the head and body of the pancreas have been reported.

The methods of surgical approach to such lesions is well outlined and while the postoperative mortality rate in the reported cases is high, yet there is offered, in the extensive surgical procedures, a definite advance in the treatment of these otherwise hopeless lesions.

The text is well illustrated and is printed on an excellent grade of paper and neatly bound. The bibliography is most complete. As a reference, this text should be available in the libraries of our larger naval hospitals.

CINEPLASTIC OPERATIONS ON STUMPS OF THE UPPER EXTREMITY, by *Rudolf Nissen, M. D. and Ernst Bergmann, M. D., New York.* 112 pages with 88 illustrations. Grune & Stratton, New York, publishers, 1942. Price \$3.75.

Cineplastic operations, while not new historically, have not in the past been widely practiced.

This short concise text discusses the accepted methods of plastic repair of the upper-extremity amputation stump which will permit

the use of an additional mechanical prosthesis, the hand of which may be used to perform movements approaching the normal.

Prostheses to replace loss of the lower extremity, especially in low thigh and leg amputations, are in general satisfactory but in cases of upper-extremity amputation, prostheses which attempt to duplicate to any degree the fine motions required of the hand and fingers by mechanical means, have not been of much value.

The method of canalization of the stump as developed by Sauerbruch is thoroughly outlined and the accompanying illustrations well portray this method.

A chapter devoted to the physiological and anatomical aspects and to the selection of suitable cases is concise, comprehensive and should be carefully studied.

There will be many cases resulting from war injuries which would be greatly helped by this type of plastic operation but such operations should only be undertaken by surgeons qualified in plastic surgery, in large rehabilitation centers, and where the intricate mechanical prosthesis is available.

The text is well written and the binding and paper of good quality.

ESSENTIALS OF PATHOLOGY, by *Laurence W. Smith, M. D., Professor of Pathology, Temple University School of Medicine*; and *Edwin S. Gault, M. D., Associate Professor of Pathology, Temple University School of Medicine*; with a foreword by *James Ewing, M. D., Memorial Hospital, New York City*. Second edition, 904 pages with 685 illustrations. D. Appleton-Century Co., Inc., New York, publishers, 1942. Price \$10.

The book is a handsomely bound treatise dealing with essentials of pathology and contains 904 pages of valuable information. It merits unqualified recommendation as it has many desirable points which enhance its value. Two of these are outstanding: The numerous well selected, plain and colored photomicrographs, and the reference illustrative cases, both of which are particularly desirable in a textbook. The case history method of teaching pathology has proven to be a constructive and encouraging method. It is a treatise, working manual, and a guide, all rolled into one; well presented and amplified material that should be very serviceable to the pathologist, clinician, and student. There is indeed a need for a book of this type.

THE MEASUREMENT OF ADULT INTELLIGENCE, by *David Wechsler, M. D.* Second edition, 248 pages. The Williams & Wilkins Co., Baltimore, Md., publishers, 1941. Price \$3.50.

The first edition of this book met with considerable acceptance both from the professional worker in this field and a considerable lay group interested in the problems of measuring human intelligence, because the book dealt with the problem as effectively as psychological knowledge and statistical methodology permit.

The second edition retains all the valuable material of the original work. Fortunately the Wechsler-Bellevue scale replaces children's tests that are still the main, though incongruous, methods of measuring adult intelligence; it covers a wide sphere of intellectual abilities, both performance and verbal. Of no little interest is the fact that it is standardized on an age range from 7 to 70 on bases typical of occupational and educational distribution at the various age levels. This scale is considered more consistently reliable than any other scale which has been tested against clinical data. The second edition is an improvement over the first by an especially valuable chapter on clinical features and diagnostic application of the scale.

The thorough discussion of the theory and practice of intelligence testing is clearly written and will greatly assist the uninitiated in an appreciation of these technics. The measures of intelligence are in accord with clinical experience. Of particular interest is the discussion of intelligence quotients that retain their meaning from the "cradle to the grave" of the subjects under investigation. In previous literature this is a standard that fluctuates for the various age levels.

The intelligence quotients tables are of great value in that they permit statisticians to use the same quotients and thus reduce material to a common basis.

CABOT AND ADAMS PHYSICAL DIAGNOSIS, by *F. Dennette Adams, M. D., Instructor in Medicine, Harvard Medical School, Courses for Graduates. Physician, Massachusetts General Hospital.* Thirteenth edition, 838 pages, illustrated. The Williams & Wilkins Co., Baltimore, Md., publishers, 1942. Price \$5.

This latest edition of Cabot and Adams' Physical Diagnosis was published in the middle of 1942. Since 1900 it has been one of the standard books on physical diagnosis in the English language. The illustrations make it almost a hand atlas of the subject and an especially fine feature is a section on the neurologic examination and the diagnosis of diseases of the nervous system. There is a splendid table showing the differential diagnosis of the various diseases which are accompanied by splenic enlargement. Another interesting chart gives a summary of the physical signs in the chest.

STARLING'S PRINCIPLES OF HUMAN PHYSIOLOGY, edited and revised by *C. Loratt Evans, D. Sc., F. R. C. P., F. R. S., LL. D., Birmingham, Jodrell Professor of Physiology in University College, London.* 8th edition, 1,257 pages, 673 illustrations. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$10.

This is the 8th edition of this standard textbook, and the fourth which has been edited and revised by Dr. Evans in the last 12 years. Such constant attention by the publishers and editor assures that the text can have in it few relics of abandoned ideas and exploded theses. I doubt if we of an older generation have any clearer way of envisaging the progress of medicine in our lifetimes than by turning back to

the primary textbooks of our student days. As the preface says "the increasing tempo of investigation * * * has made inevitable a change in that ample and leisurely atmosphere which was so attractive a feature of the earlier editions."

All subheads are treated unusually exhaustively. The volume presents a comprehensive and accurate picture of physiology as it stands today. The greatest change is in the section dealing with the central nervous system. Recent investigations, though still possibly not fully established, are included.

The endocrines are given 40 pages, well illustrated. One criticism might be that the vitamins are covered too cursorily. But in its entirety it is probably as full in its coverage as any textbook on physiology now on the market.

THE THERAPEUTICS OF INTERNAL DISEASES, edited by *George Blumer, M. A., (Yale), M. D., David P. Smith Clinical Professor of Medicine, Yale University School of Medicine; and Albert J. Sullivan, M. D., Chief Medical Officer, Galinger Municipal Hospital, Washington, D. C.* Five volumes, 4208 pages. Second edition. Wilcox & Follett Co., Chicago, Ill., publishers, 1942. Price \$50 per set.

That time honored word "monumental" can well be used to refer to this five-volume work on therapeutics. It is of course a compilation of monographs by a number of authors. Consequently it has the defects of this method. However these defects are as few as it is possible to have in a work of this character. The first volume covers general therapeutics and therapeutic technic. One of the most interesting sections is one devoted to the therapeutic use of gases, including valuable practical material on the use of helium. In volume II is an extensive section on pharmacology and toxicology, followed by the therapeutics of the infectious diseases including the virus diseases. Volume III deals with the mycoses, protozoa, acidosis, and alcoholism. In volume IV the treatment of diseases of the gastrointestinal tract, genitourinary tract and blood-forming organs is covered, and in the last volume are the nervous system, and diseases of metabolism, endocrine organs, and the skin. There is an extensive section on the sulfonamides and a very good general index. This is a particularly useful book for a practitioner to have, for turning to it is almost like a consultation with an internist who is a specialist in some particular field.

CLINICAL ANESTHESIA, a Manual of Clinical Anesthesiology, by *John S. Lundy, B. A., M. D., Head of Section on Anesthesia, Mayo Clinic, Professor of Anesthesia, Mayo Foundation for Medical Education and Research.* 771 pages with 266 illustrations. W. B. Saunders Co., Philadelphia, Pa., publisher, 1942. Price \$9.

"Clinical Anesthesia", by Lundy is the answer to the need for an authoritative volume adequately covering the entire field of anesthesia. It represents the opinions and describes the technic of a man who has

had a vast experience both as a teacher of anesthesiology and as a clinical anesthetist.

This book not only describes the accepted technics but suggests the means of acquiring the dexterity and precision that one usually attains through years of experience and which marks the difference between a struggling anesthetist and a polished one.

The illustrations are excellent and most of them are original. The arrangement of text is so logical that it requires only a few minutes to review the salient facts about the subject being discussed.

The reviewer feels that "Clinical Anesthesia" is so worth while that it should be available to all anesthetists and to surgeons interested in anesthesia.

DISABILITY EVALUATION, Principles of Treatment of Compensable Injuries, by *Earl D. McBride, B. S., M. D., F. A. C. S., Diplomate American Board Orthopedic Surgery, Assistant Professor in Orthopedic Surgery, University of Oklahoma School of Medicine.* Third edition, revised, 631 pages with 374 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$9.

This is the third edition of this excellent book and since the publication of the first edition the author has done much good work in giving the specialist and general practitioner a better understanding of the subject of physical disability as it pertains to economic loss to labor and to industry. In the first edition the author practically pioneered in this field.

The author has attempted to formulate a uniform system of arriving at percentage conclusions and he has recognized that much difficulty lies in the fact that there is great difference in the attitude of physicians toward making evaluations of disability in terms of percentage. He has given his percentage tables as a means of trying to establish a uniform means of estimating these losses.

He has divided his book into 35 chapters. Chapter 1 deals with the definition of disability, its origin, medical aspects of disability, etc. Chapter 2 gives in detail the doctor as an expert witness—that is, the "do's and don'ts" for a doctor on the witness stand. The next few chapters deal with workmen's compensation laws standardizing medical evaluation of disability and the procedure of analysis in evaluating disability. Chapter 6 deals extensively with the examination of the disability present. The remaining chapters of the book deal with the various localities of the injuries such as ankylosis of the various joints, fractures of the various bones, burns, hernia, etc.

Included within the book are 25 pages of fine print on green paper with the author's composite schedule of the approximate evaluation of practical permanent disability and gives the method of using this schedule.

The book is well-illustrated, contains many drawings, photographs, and tables. It is well-indexed and contains an extensive bibliography. This book is a must for all those doing any type of industrial surgery.

PREVENTIVE MEDICINE IN MODERN PRACTICE, edited under the auspices of *The Committee on Public Health Relations of The New York Academy of Medicine*, by James Alexander Miller, Chairman; George Baehr, Former Chairman; and E. H. L. Corvin, Executive Secretary. 851 pages. Paul B. Hoeber, Inc., New York, publishers, 1942. Price \$10.

This is a new book which appears under the auspices of The New York Academy of Medicine, and is the work of a long list of distinguished contributors. It has in consequence all the merits and some of the faults of composite authorship. In spite of careful editing, there is some overlapping of material and, as is bound to be the case, inequalities in style and character of presentation. There are practically no illustrations, which this reviewer believes to be a fault in any book on preventive medicine. The work is comprehensive and many subjects which are usually not covered or are dealt with very inadequately are given prominence. Particularly is this the case with public health problems of childhood, of maternity, and certain gynecological problems. There is a section on preventive medicine in relation to the skin, another commonly neglected subject in preventive medicine, as well as preventive medicine in relation to surgical conditions and degenerative diseases. Of interest to the naval medical officer is the recommendation for an individual health record for all patients in the country. This valuable feature, which was originated by the Medical Department of the Navy, might well be universally adopted with great benefit.

ESSENTIALS OF MEDICINE, by Charles Phillips Emerson, Jr., A. B., M. D., *Research Fellow in Medicine, Harvard Medical School*; and Jane Elizabeth Taylor, R. N., B. S., M. Ed., *Assistant Professor of Medical Nursing, Yale University School of Nursing*. 14th edition, revised and reedited, 892 pages with 195 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.25.

This latest edition of "Essentials of Medicine" classifies diseases into units as they affect the various systems of the body.

Terminology and phraseology enable both the student and graduate nurse to visualize the effect of an existing disease, thus giving them a broader understanding of fundamentals so that they may put into practice the principles of medical treatment as applied to nursing care.

Comprehensive and relevant material has been incorporated in the section on nutritional disorders. Included also is a chapter on the sulfonamides.

Illustrations are up-to-date in method and photographically; references are present at the end of each unit.

This book should prove a valuable addition to the increasing number of worth while nursing books.

INTRODUCTION TO THE PRINCIPLES OF NURSING CARE, by *Martha Ruth Smith, M. A., R. N., Assistant Principal and Supervisor of Instruction in Nursing Practice, Massachusetts General Hospital, Boston; and Jean Broadhurst, Ph. D., Professor of Bacteriology, Teachers College, Columbia University, New York City; and 10 contributing authors.* 2d edition, revised, 660 pages with 83 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.

In this revised text particular emphasis has been placed on the nursing care of the very sick patient. The nursing procedures are carefully detailed with many illustrations demonstrating the proper technic of movement of patient, and treatments.

There is a comprehensive survey of ethics of the nurse toward the patient, doctor, and the patient's family; at the same time, it touches lightly on the nursing care in the home, and the effect of the patient's home environment on the nurse versus the effect of the hospital environment on the "new patient."

There are excellent sketches of charts, clinical, intake and output, and various tables and summaries. Valuable illustrations are given of "withdrawal of body fluids," as well as intravenous and subcutaneous injections of liquids, and aseptic technic.

There are chapters on remedial nursing procedures for alimentary tract conditions, urinary tract, as well as the nose and throat. Brief description of the use of the oxygen tent is also included in this chapter. The closing portion of the book deals with a reference section concerning definitions and symptoms. It also casually mentions insecticides, stains, and their removal.

Throughout the book, the authors have kept the beginning student nurse in mind, and have maintained an even balance between established procedures and new points of view. Therefore, the reviewer thinks it will be a valuable guide to all nurses.

MICROBIOLOGY AND PATHOLOGY FOR NURSES, by *Mary Elizabeth Morse, A. B., M. D., Formerly Pathologist to the Boston State Hospital; Martin Frobisher, Jr., S. B., Sc. D., F. A. P. H. A., F. A. A. S., Associate in Bacteriology, The Johns Hopkins University; and Coleman B. Rabin, B. S., M. D., Lecturer in Pathology, Mt. Sinai Hospital School of Nursing, New York.* 575 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$3.25.

This combined text on microbiology and pathology is a particularly skillful presentation for nurses. It is divided into six major units: 1. General Principles; 2. Asepsis, Disinfection, and Sanitation; 3.

Infection, Immunity, and Allergy; 4. Special Bacteriology; 5. General Pathology; 6. Clinical Pathology.

The microbiological section of the text not only presents the theoretical side but also the application of the material to actual nursing while the pathological section orientates the relationship of disease structure to function by emphasizing the causes and development of disease.

Contained throughout the book are 208 illustrations. A competent glossary, a pertinent section on experiments and demonstrations, a fine condensed chart of the common pathogenic organisms discussed in the book, and an adequate index comprise the definitely outstanding features of the edition.

Conclusively speaking, this book is an excellent synthesis of microbiology, pathology, and nursing technics.

A TEXTBOOK OF MATERIA MEDICA, PHARMACOLOGY AND THERAPEUTICS, by *Harold N. Wright, M. S., Ph. D., Associate Professor of Pharmacology, University of Minnesota*; and *Mildred Montag, R. N., M. A., Formerly Instructor in Nursing Arts, St. Luke's Hospital, New York City*. Second edition, revised, 647 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$3.

This textbook of Materia Medica, Pharmacology, and Therapeutics is an excellent presentation, being concise and to the point and invaluable to all nurses.

Each chapter contains well organized, clearly stated, factual material which deals with the more important types of drugs, their action, administration, toxic manifestations, and dosage.

The following chapters are noted as being outstanding:

Chapter 9—Administration of Drugs.

Chapter 10—Pharmacological Action of Drugs.

Chapter 11—Drugs Producing Stimulation of the Central Nervous System.

Chapter 12—Drugs Producing Depression of the Central Nervous System.

Chapter 25—Drugs Used in the Chemotherapy of Bacterial Infections.

Chapter 30—The Effects of Salts on the Blood and Tissues.

Chapter 33—Biological Preparations. Vitamins and Digestive Ferments.

Chapter 35—Toxicology.

It is the reviewer's opinion that this is an outstanding book in the field of materia medica and should be in the possession of all nursing art instructors, and graduate and student nurses.

Besides being well written, this edition contains a complete index and glossary together with much illustrative material.

SYNOPSIS OF FULL AND PARTIAL DENTURES, by *Roger G. Miller, D. D. S., Lieutenant Colonel, Dental Corps, U. S. Army; Officer in Charge of Prosthetic Department, Army Dental School, Army Medical Center, Washington, D. C.* 221 pages with 107 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$3.

The Synopsis of Full and Partial Dentures, by R. G. Miller is adequate for those in general practice who construct an occasional pros-

thetic appliance. The full denture section is very elementary. The partial denture portion leaves much to be desired as does his technic for immediate dentures. The chapter on maxillofacial prosthesis is excellent and the description of moulage is splendid.

INTERNAL MEDICINE IN DENTAL PRACTICE, by *Bernard I. Comroc, A. B., M. D., F. A. C. P.*; *Leon H. Collins, Jr., A. B., M. D., F. A. C. P.*; and *Martin P. Crane, B. S., M. D.* 543 pages with 76 engravings and 6 colored plates. Second edition, enlarged and thoroughly revised. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$5.50.

While this book discusses in great detail many of the essentials of medicine which a dentist requires, it does not entirely cover the subject. More space might have been allotted to the study of oral tissues and their relationship to focal infection, as applied to the various systemic diseases. The subjects of allergy, deficiency diseases, and vitamins which play an important role in oral lesions could probably have received more attention.

The chapter devoted to the sulfonamides is very interesting. The application of these drugs in the treatment of dental cases is thoroughly discussed.

It would be well if every practitioner could become familiar with the contents of this book.

AMBASSADORS IN WHITE. The Story of American Tropical Medicine, by *Charles Morrow Wilson.* 372 pages, illustrated. Henry Holt and Co., New York, publishers, 1942. Price \$3.50.

This is a deviation from the revealing intimacies of medical biography which has had such current popularity in recent years.

The author from a close intimacy with the southern Americas gives us a monograph on mosquitoes, malaria, and yellow fever, built around excellent chapters featuring the lives and achievements of Finlay, Reed, Gorgas, Deeks, and Noguchi.

It is a very good refresher on the past and present of the yellow fever and malaria status in Latin America. The other regional diseases, infectious and nutritional, are also sketched though less extensively.

Sanitation and food problems are well covered, with description of national and company activities in connection with these.

It is well illustrated and is accompanied by a comprehensive bibliography.

It appears that the best evaluation of sulfonamide compounds, as used in treatment of war wounds, would be derived from comparing the rate of infection in wounds sustained under present conditions, wherein sulfonamides are used almost routinely, * * *, with the rate of infection in wounds sustained in the war of 1914-18, when sulfonamides were not available. The rate of infection in wounds studied by bacterial culture at casualty clear-

ing stations in the war of 1914-18, was, according to available data, 75 percent or more. For example, Stokes and Tytler, of the British Army, obtained 310 cultures of aerobic bacteria out of 365 specimens taken, an infection rate of 85 percent. In their series all attempts at culture were made within twelve hours after infliction of the initial wound. Certainly, it is difficult to conceive of infection rates this high with the present use of sulfonamides. * * *

The question of the drug of choice and its method of administration in lacerations and wounds may not yet be settled. Of the many compounds available, the choice for local use probably should rest among sulfanilamide, sulfadiazine, and sulfathiazole. Little difficulty has been experienced following the local use of powdered or crystalline sulfanilamide. Some of the difficulties with sulfathiazole may easily be due to the rather large amounts of material used and to the fact that it has not been dispersed evenly over infected surfaces. If finely powdered or crystalline sulfathiazole is dispersed as a thin coating rather than being "packed" in these wounds, much of the irritation and foreign body type of reaction can be avoided. Sulfathiazole, from the point of view of its antibacterial activity, is polyvalent and is not a local irritant. If the mechanical problems involved in its application can be overcome, it is obviously superior to the monovalent compound sulfanilamide. Sulfadiazine may closely compare with sulfathiazole. The report of Green and Parkin in a recent number of the *Lancet* seems to confirm the belief that sulfathiazole is the superior drug.

The "antisulfonamide" action of pus and tissue exudate may easily be overcome by frequent cleansing of infected surfaces, followed by reapplication of the powdered drug. This is essential in the early stages of infection. * * *

Sulfapyridine and, to a lesser degree, sulfadiazine are definite peritoneal irritants and should not be employed for this type of therapy. Sulfanilamide meets some of the criteria postulated above. It is not a peritoneal irritant and does not depress the local peritoneal defense mechanisms. On the other hand, it remains in the peritoneal fluid for only 24 hours or even less. It is monovalent rather than polyvalent. Sulfathiazole is polyvalent. The material does not entirely leave the peritoneal fluid for a period as long as 4 or 5 days. Concentrations in the peritoneal fluid of 400 or 500 milligrams per 100 cubic centimeters are present following instillation of 5 to 10 grams. Cellular elements, particularly the mononuclear phagocytes, are markedly stimulated. There is no evidence of peritoneal irritation. Abdominal cavities opened subsequent to use of sulfathiazole have not revealed evidence of abnormal adhesions or other untoward effects. * * *

Local or intraperitoneal chemotherapy obviously does not displace accepted rational supportive and surgical procedures. All of the procedures are complementary. Disagreements and clinical contradictions are products of misunderstanding of the principles concerned in the successful application of all available methods of attacking wound infections.—Herrell, Wallace E.: Editorial, the local and intraperitoneal use of sulfonamide compounds. *Surg., Gynec. & Obst.* 76: 247-249, February 1943.

THE DIVISION OF PREVENTIVE MEDICINE

Commander T. J. Carter, Medical Corps, United States Navy, in charge

HAM-BORNE STAPHYLOCOCCAL FOOD POISONING ¹

By VAN C. TIPTON, Commander, Medical Corps, United States Naval Reserve,
and DEAN F. SMILEY, Lieutenant Commander, Medical Corps, United States
Naval Reserve.

In 1914 Barber (1) reported an outbreak of food poisoning in which *Staphylococcus albus* was demonstrated as the causative agent. Yet the significance of staphylococci in such outbreaks was not realized until 1930 when Dack, Cary, Woolpert, and Wiggers (2) reported an outbreak due to cream-filled layer cake contaminated with hemolytic *Staphylococcus aureus*. They were able to produce typical symptoms of food poisoning by feeding sterile broth filtrates of this strain of staphylococcus to human volunteers. During the same year Jordan (3) demonstrated that other strains of staphylococcus could produce food poisoning by their toxins and in the following year he reported additional outbreaks (4).

Since that time many outbreaks have been reported. Of the various attempts to devise relatively simple diagnostic tests, the kitten test of Dolman, Wilson, and Cockcroft (5) was the most satisfactory, yet it was not universally accepted. Later Davison, Dack, and Cary (6) have shown that the intravenous injection of filtrates into monkeys or kittens was more delicate than the intraperitoneal injection as advocated by Dolman. The difficulties encountered in obtaining and caring for these animals make it quite unlikely that many naval activities will use such tests routinely.

The causative agent in staphylococcal food poisoning is an enterotoxin, which is relatively thermostabile. Only a fraction is destroyed by boiling for 30 minutes, and it is not completely destroyed by autoclaving at 121° C. for 20 minutes (7), differentiating it definitely from the hemolytic and necrotizing toxins of the staphylococci. Not much is known about conditions favoring its production, but starch-containing media or salt-cured meat seem favorable. Reports indicate that only a short time (as little as 4 hours) is required for the production of enterotoxin in amounts sufficient to cause symptoms.

¹ Received for publication December 30, 1942.

Symptoms are distinct enough to differentiate staphylococcic toxin outbreaks from those due to infection with the *Salmonella* group.

In the staphylococcic enterotoxin type the incubation period is short, ranging from 1 to 8 hours, usually 2 to 4; onset is usually marked with abdominal cramping and nausea, followed by vomiting and diarrhea. The vomiting is often severe and frequent. The acute stage ordinarily lasts from 6 to 8 hours, during which marked prostration is often present; temperature is normal or subnormal. Following the acute stage there may be a slight elevation of temperature. Recovery is rapid and complete within 24 hours, save for weakness, except in severe cases. Deaths are rare.

In the *Salmonella* infection type the incubation period ranges from 6 to 24 hours, usually longer than 8; there is a longer acute stage with fever, and recovery is delayed for several days. Mortality rate averages 1 to 2 percent.

The potential sources of contamination of food with staphylococci are numerous, beginning with the first stages of handling, whether it be a packing house, dairy, bakery, or galley, and extending to the steam plate. It is believed by some that most contamination is acquired in the galley, and that the production of enterotoxin is favored by unduly long exposures to room temperature, warming ovens or steam plates. Foods incriminated frequently include cream- or custard-filled bakery products, salt-cured meats, particularly the ready-to-eat hams and beef tongues, and occasionally milk, cheese, gravy, hollandaise sauce, turkey, egg, and potato salad (8). In the experience of the Navy and Marine personnel ham is the most frequently involved, while the infrequently encountered foods have been milk, chop suey, hash, and chicken salad.

Typical reports are quoted:

Report 1. "Saturday afternoon, October 3, 1942, at about 1630. 2,128 patients reported to the dispensaries showing typical signs of gastro-enteritis, acute. Three hundred and seven men were transferred to the United States Naval Hospital for treatment. These patients, without exception, came from one camp and were served the same noon meal as the other mess halls on the station, and inasmuch as there were no complaints from other activities, it is assumed the cause was in the preparation or handling of the food rather than the food itself. Four thousand men ate this meal at this mess hall.

"The menu (served at noon) consisted of:

"Navy bean soup, crackers, boiled ham, sliced pickles, boiled cabbage and turnips, boiled peeled potatoes, bread and butter, apple pie, coffee.

"The ham was boiled the previous afternoon, not chilled and allowed to stand until 0500, October 3, 1942, in open pans, at which time it was sliced for the noon meal.

"A sample of each item on the menu was examined by the Station Laboratory and by the Hospital Laboratory. Findings by both of these laboratory examinations revealed that the ham was contaminated with many *Staphylococcus aureus*. No culture was made of vomitus or stools.

"All patients with the exception of nine men were returned to duty October 5, 1942. These nine men were retained in the hospital for treatment of colds."

Report 2. (a) "On October 2, 1942, 4 hours following the noon mess at mess halls Nos. 1 and 4, some 1,010 cases of food poisoning occurred."

These messes were attended by about 8,000 troops.

"The etiological factor was determined to lie in the preparation in these mess halls of smoked hams, which bore the stamp of U. S. Army 'Inspected,' dated September 29, 1942. These hams showed no evidence of deterioration by appearance, consistency, or odor."

The incidence of food poisoning and the preparation of the hams in the several mess halls are described below.

"Mess hall No. 1 developed 360 cases of food poisoning. About 4,000 men are fed in this mess hall. The hams were boiled from 2400 on October 1, 1942, to 0300 on October 2, 1942. They were then immediately boned and sliced and were left exposed in pans in the galley until served at 1100 on October 2, 1942.

"Mess hall No. 4 developed 650 cases of food poisoning. This mess serves about 4,000 men. The hams were boiled from 2100 on October 1, 1942, to 0100 on October 2, 1942, and were also immediately boned and sliced. The sliced ham was left exposed in pans in the galley until served at 1130 on October 2, 1942.

"In Mess hall No. 3 ham was not served and no cases of food poisoning occurred.

"The evidence submitted above indicates conclusively that the preparation of the ham was the prime factor concerned in this epidemic of food poisoning. It is not uncommon for boiled or baked sliced ham exposed at room temperatures for periods of 4 to 7 hours to become grossly contaminated from flies, superficial infected wounds on the hands and forearms of the messmen, or from contaminated meat blocks, knives, pans or other utensils used in the preparation of meat."

Report 2. (b) "On October 15, at about 1600, 50 cases of food poisoning from mess hall No. 1 reported to the field hospital for treatment.

"On October 16, at about 0830, some 300 cases of food poisoning from mess hall No. 1 reported to the field hospital for treatment.

"Mess hall No. 1 messes some 4,200 men. With the present butcher detail the time required to bone hams for 4,200 men is approximately 10 to 11 hours. The time required to slice these hams, using two slic-

ing machines and assorted crew of messmen cutting by hand, is approximately 8 hours. The total time required, therefore, in the preparation of meat for serving is approximately 18 hours. During this whole time the hams are subject to contamination by hands, flies, and other sources of infection, such as food handlers with colds, and improperly washed kitchen utensils.

"The circumstances surrounding this outbreak of food poisoning are briefly as follows:

"Sliced ham served at the noon mess, October 15, resulted in some 50 cases of food poisoning 4 hours later. The personnel in charge of mess hall No. 1 claim no knowledge of this outbreak, in consequence of which (*sic*) left-over ham was ground up, placed in the refrigerator, and served the following morning in scrambled eggs. The time interval between ingestion of food and outbreaking of food poisoning was now only 1 hour and the resulting cases were far more sick than those of the preceding night. It is quite clear that this shorter time interval and more severe illness resulted from the intermixture of both contaminated and uncontaminated ham, and the incubation period of some 16 hours before this ham was served allowed for marked increase in bacteria and bacterial poisons in said ham."

Report 3. "On January 3, 1942, there were 225 cases of food poisoning on this station.

"The outbreak was explosive in type affecting approximately 150 men between the hours of 1330 and 1700. The remaining continued to report until 2400, when the last man reported for treatment. There were no mortalities. Forty-seven required official admission to the sick list and one case resulted in a complication of appendicitis, acute.

"Investigation revealed that all men affected had eaten ham steak served at dinner on that date. The previous meals were investigated also but no significant data resulted. Tabulation also revealed that the contamination was present in the first servings. Most significant was the fact that the senior medical officer, who had inspected the meal and eaten a small sample of ham only, was also affected.

"The suspected hams (hams, smoked, sweet pickled—type 1, grade 1) were received on this station December 30, 1941, and delivered by the trucking firm of same city. The hams were not frozen, chilled or frosted and were immediately placed in the chill box until 1400 January 2, 1942, then taken from the ice box and were boiled for 3 hours. They were removed from the coppers at 1800 and placed in dishpans and allowed to cool, unprotected, until about 0500 January 3, when they were sliced by hand and placed into shallow pans. Slicing was completed at 0730 and the pans remained uncovered on the dresser table until 0900 when they were placed in the ovens and

cooked for one-half hour at 350–400° F. Thereafter they were placed in steam tables until time of serving at 1130 to 1215.

“Ham Chronology.

December 30, 1941: Received.
January 2, 1942: 1500-1800. Cooked.
January 3, 1942: 0530-0730. Sliced.
January 3, 1942: 0900-0930. Cooked.
January 3, 1942: 0930. To steam tables.
January 3, 1942: 1130-1215. Served.

“Bacteriological Report from United States Naval Hospital is as follows:

A. Items:

Pickled ham—1 specimen—*Staph. aureus* predominant, also gram-positive bacillus.

Cooked whole ham—1 specimen—almost no bacteria present.

Uncooked whole ham—1 specimen—*Staph. aureus* present in considerable numbers.

Hand washing (7 specimens):

- (a) *Aerogenes* type bacteria.
- (b) *Staph. aureus* and *albus*.
- (c) *Staph. aureus* and *albus*.
- (d) *Staph. aureus* and *albus*.
- (e) *Staph. aureus* (few).
- (f) *Aerogenes* type bacteria.
- (g) *Aerogenes* type bacteria.

Ham trimmings—few bacteria.

Jelly from cooked ham—Aerobic spore producers and molds.

B. No *Salmonella* organisms observed in any of the specimens examined. Anaerobic cultures were negative for *Botulinus* organisms.

“The uncooked ham specimens which show *Staphylococcus aureus* present in considerable numbers indicate that these hams were contaminated prior to arrival on this station. The three hams submitted were not handled by any member of the galley force. They were allowed to remain in the original packing case until removal for analysis, at which time clean wrapping paper was used to pick them up and before wrapping in same.

CONCLUSIONS

“1. That the sweet pickled, smoked hams were contaminated by *Staphylococcus aureus* prior to delivery and caused 225 cases of food poisoning.

2. That too short a period of time was allowed for cooking these hams.

3. That too long a period elapsed prior to slicing the hams.

4. That too long a period of time elapsed prior to baking the hams.

5. That the baking time was too short and heat inadequate.

6. That keeping cooked hams unprotected in between above galley operations allowed further bacterial growth and probable hand contamination.

7. That other articles of the menu were concurrently contaminated following the serving of the meal.

RECOMMENDATIONS

"1. More rigid Federal food inspection be directed for this type of smoked, sweet pickled, whole hams.

2. Longer periods of cooking for hams of this type—preferably 5 hours.

3. Rigid adherence to Bureau of S. and A. Manual article 1131-B, which covers the preparation and proper handling of hams.

4. Rigid hygienic standards for all galley personnel."

Report 4. "On June 6, 1942, an epidemic of food poisoning, bacterial, occurred at this station. One hundred seventy-one persons reported to the dispensary for treatment; 70 of these being admitted to the sick list; 68 of these patients were on the sick list 1 day and 2 for 2 days.

"The epidemic was well distributed among 8,300 persons partaking of the offending meal. The incidence and severity rates among the various Army, Navy, and Marine Corps groups were quite constant.

"The persistent item of the bill of fare eaten by all the affected persons was boiled smoked ham.

"The clinical picture of most of the affected persons was quite typical of a staphylococcic exotoxin gastroenteric disturbance. Symptoms in early cases appeared within 2 hours after intake, and in late cases as long as 8 hours. The first symptoms were nausea or mild abdominal cramps followed by vomiting, varying from a simple emptying of the gastric contents to quite prolonged retching, and diarrhea varied from simply a watery stool to severe cramps and tenesmus. The other predominant symptom, simple dehydration, followed as a matter of course; no case being severe enough to require parenteral fluids, nor did any case show clinical evidence of an upset of the acid base balance. Temperature, pulse, and respiration were normal to subnormal in the main.

"The outstanding clinical finding in this group was a negative one. There was little or no systemic toxic depression. The men did not feel ill, they simply vomited and had diarrhea, a point which was helpful in eliminating the *Salmonella* group or botulin as a factor of origin.

"It was possible to obtain specimens of the ham and the salad which were sent to the laboratory. As the ham was soon established to be the offending food, a history was taken to find the point of contamination. The ham used for this meal was purchased on June 4, 1942. It was the 24-hour smoked type. These hams are received by the local packer in a pickled state, are smoked and packed and delivered without storage. Each ham was inspected by the naval inspector before packing. On arrival at this station, the hams were stored in a refrigerated space which is maintained at a temperature between 31° to 34° F. At 0100 on July 6, 1942, these hams were removed from storage and placed in large steam coppers for cooking. At 0330—

2½ hours later, the hams were removed and placed on tables in the galley to cool and then were skinned and boned. Four men did this operation and finished at 0700. The skinned and boned hams were placed in flat roasting pans, 8 to 10 a pan, and placed in an oven with heat of 200° F. On the average, these pans were in this heat 90 minutes. At 0900 slicing began; 15 men slicing the meat and 4 men putting the sliced meat in the same pan, after which these pans were placed in the oven at the same temperature, 200° F., to await serving. The average time this sliced ham was in the oven was 45 minutes. From this point the ham was carried to the serving lines for consumption. The same persons served the meat that sliced it.

"Case histories showed that contaminated meat was served on all of the six serving lines and on all three of the noon messes.

"The conclusions of this study were that the hams were potable until they were sliced, the 3½-hour cooking and the 90-minute oven exposure after boning being sufficient to destroy pathogenic bacteria. The absence of a localized source at one feeding line showed that the food was contaminated before it came to the serving line. The logical time of contamination appeared to be during the slicing process. Examination of the 15 persons engaged in the slicing operation revealed an infected wound in the left ring finger of one of the slicers. Smears and cultures were taken.

"The laboratory reported a growth of both staphylococcus and *Salmonella* from the ham, *Salmonella* from the salad and staphylococcus from the food handler's finger. It is believed that the *Salmonella* was incidental and not pathogenic. Further study is being carried out to establish the source of this organism in the food samples taken.

"The final conclusion reached in studying this epidemic is that this epidemic was directly traceable to a staphylococcic infection on the finger of one of the meat slicers. This conclusion was arrived at in view of the history of the food, the patients' histories, and the laboratory findings.

"This epidemic points out the need of several things at this station:

"(1) Closer supervision of food handlers, especially by responsible persons directly in charge of groups; (2) enlargement of galley force and space (this galley was built to handle 3,000 men; whereas 8,600 men are being fed) so that food need not be prepared so far in advance. For instance had the food been served immediately following boning and slicing, the incubation period would have been eliminated; further, had this slicing been done by machine, the number of sources of contamination would have been reduced. Another factor which becomes evident and is an important point from a military standpoint is, in feeding a large force, such as is stationed at this activity, two separate galleys should be established to eliminate the exposure of the entire personnel to the hazard of food poisoning. In case an epidemic of food poisoning should occur coincidental to a surprise attack, the defense would be pitiful."

The outstanding features in these reports are:

(1) The frequent involvement of ham in staphylococcal food poisoning outbreaks; (2) the unnecessarily long periods of exposure of ham to temperatures favorable to bacterial growth which were apparently permitted after boning and slicing; (3) exposure of the hams to heat in cooking for a period of time which was insufficient, according to Rosenau (9).

Report 3 is apparently an illustration of ham contaminated before cooking. These hams, if sterilized in cooking, might have been recontaminated in preparation. The report of the cultures of handwashings of seven of the galley personnel shows that there were ample opportunities for such recontamination. This is again illustrated by report 4 where the source of the *Staphylococcus aureus* was apparently a pustular lesion on one of the food handlers.

In view of the practically universal distribution of staphylococci and the overtaxed condition of many of our messes special attention should be directed to the prevention of further outbreaks. Although completely satisfactory methods of preventing ham-borne food poisoning are not yet at hand, the following measures are known to be helpful:

1. The cooking of hams should be such as to attain a temperature of 140° to 158° F. at the center of the ham; this necessitates prolonged cooking since even after 2 hours of boiling, temperatures in the center of the ham may still be only 115° to 153° F. (9). Four to five hours cooling is to be recommended.

2. When removed from the range, ham should be promptly chilled and kept at a temperature not exceeding 45° F. Boning and slicing should not be done until a short time (not more than 4 hours) prior to serving.

3. Contamination of the ham in the boning and slicing process (which appears to be the process in which contamination most frequently occurs), should be guarded against by (a) inspection of galley personnel for cleanliness and freedom from pustular lesions of the hands or forearms; (b) warning galley personnel against contaminating the food by "sampling" or by cough spray; (c) protection from flies (10).

4. After slicing, the ham should be spread in shallow containers covered with waxed paper. As sliced each tray should be immediately chilled and kept in a refrigerator at a temperature not exceeding 45° F. until serving time (10).

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OBSERVATIONS ON "CATARRHAL FEVER"¹

By J. E. LUDWICK, Lieutenant Commander, Medical Corps, United States Naval Reserve, and BEN C. JONES, JR., Lieutenant, Medical Corps, United States Naval Reserve

Shortly after we begin our tour of duty as medical officers in the Navy we become familiar with the term "catarrhal fever" as applied to upper respiratory infections, those usually diagnosed as cold, grippe, acute pharyngitis, rhinitis, laryngitis, or rhinopharyngitis. The practicability of the term "catarrhal fever" in simplifying the nomenclature is obvious. In 1920 B. Fantus² recommended that since it is practically impossible to differentiate between influenza, grippe, and the common cold, the old term "catarrhal fever" be used generally as a convenient designation for this group of clinical conditions. It is also apparent, without resorting to statistical analysis, that catarrhal fever is the principle cause of loss of time from work in the Navy, and in many cases it is a serious disease, progressing to pneumonia.

This brief study, carried out at a west coast shore station, was prompted by our wish to attempt to answer the following questions: What is the average percent of personnel incapacitated by catarrhal fever during a summer month when the incidence of upper respira-

¹ Received for publication September 8, 1942.

² Fantus, B.: Therapy of catarrhal fevers. *J. A. M. A.* 75: 1664, Dec. 18, 1920.

tory infection is low? What percent of the cases with catarrhal fever develop pneumonia? Since it is thought that microorganisms act as secondary invaders after the inception of the infection by a filtrable virus we wondered if the course of the more serious cases of catarrhal fever could be shortened by administration of sulfonamides. We wondered also whether or not the incidence of pneumonia developing in cases of catarrhal fever could be reduced by administration of sulfonamides, but in this respect our series is too small to be of significance.

From inquiries made among the older medical officers and pharmacists we have found that the term "catarrhal fever" was first incorporated in the nomenclature after the last war (1925-Ed.), because after the subsidence of the great pandemic of influenza it was desired to stop the diagnosing of sporadic cases of respiratory infections as epidemic influenza.

For 4 weeks, from July 27 to August 22, 1942, inclusive, we studied all the cases of catarrhal fever admitted to the ward of this dispensary. The average personnel of this station during that period was 7,500. From that group 130 men were sick enough with catarrhal fever to require bed rest and nursing care. This was an average of 1.7 percent, which is roughly calculated as amounting to 2,288 man-hours of working time. Out of the 130 cases of catarrhal fever 13, or 10 percent, developed pneumonia. Out of these 13 cases there was 1 of lobar pneumonia, and 12 cases of bronchopneumonia or so-called pneumonitis, the latter diagnosis being made on the basis of x-ray findings of small areas of pulmonic infiltration. The 13 cases of pneumonia were confirmed by x-ray and were transferred to the hospital within a few hours after the diagnosis was established. No bacteriological work could be carried out at this dispensary. Of the 13 pneumonias, 5 cases (not including the one lobar pneumonia) received sulfathiazole from the day of entry. In none of the 5 was there any noted improvement while under sulfonamide therapy. This suggests that the pneumonic infiltration was not due to coccic infection. No case had a leukocytosis of over 14,000, the average was 9,500, and the lowest count was 8,000. Schilling counts were not completed in all cases.

No case was discharged from the ward until his temperature had been normal from 4 to 24 hours. The average stay in the ward of all patients of this series was 56 hours.

All patients who had a temperature of 101° F. or over on entry due to uncomplicated catarrhal fever were given sulfathiazole gr. 15 every 4 hours until their temperatures were normal. There were 31 in this group. Their average time on the sick list was 68 hours.

Of the uncomplicated cases of catarrhal fever who were not given sulfathiazole there were 86. These patients were on the sick list for an average of only 48 hours.

Although only the more acutely ill cases were given sulfathiazole, the difference in the average stay of the two above groups is significant enough to suggest that the drug did nothing to alter or shorten the course of the patients who received it. It has already been noted that five patients who received sulfathiazole from the day of entry developed definite demonstrable areas of pneumonic infiltration while receiving chemotherapy.

CONCLUSIONS

1. Catarrhal fever must be considered as serious since in this series 10 percent developed pneumonia in some form, though no case was severely toxic.
2. Catarrhal fever is usually a self-limited disease which spends itself in an average of 56 hours.
3. In our series sulfathiazole did not alter or shorten the course of catarrhal fever.
4. We have no evidence to show that pneumonia may be prevented by the administration of sulfathiazole to patients with catarrhal fever.
5. Lobar pneumonia was an infrequent complication in this study, occurring in only 1 out of 130 cases.

YELLOW FEVER ¹

A SURVEY TO THE PRESENT

By JOHN E. EMMETT, Lieutenant, junior grade, Medical Corps, United States Navy.

In the late twenties of this century, medical men interested in and acquainted with the magnificent work already done toward ridding the world of yellow fever regarded the early completion of the task as practically an accomplished fact. And then, in 1928, the disease suddenly appeared again in Rio de Janeiro where it had not been seen for 20 years. The outbreak was rapidly controlled and once again the coastal cities were free of the disease; but, strangely, and contrary to past experience and expectation, it persisted in various parts of the interior, even after the key centers were clean and incapable of reinfesting the jungle lands. With this began the realization that the mystery of yellow fever was not yet completely solved, and yellow fever entered into what may be called the third period of its history, while the hope of complete and rapid eradication of the disease from the face of the earth faded in the minds of those but a short time before so assured.

¹ Received for publication July 7, 1942.

Sir William Osler (1) defined yellow fever as "a fever of tropical and subtropical countries, caused by a filtrable virus and characterized by a toxemia of varying intensity, with jaundice, albuminuria, and a marked tendency to hemorrhage, especially from the stomach, causing the "black vomit." It is transmitted by the bite of the infected mosquito, the *Aedes aegypti* (*Stegomyia fasciata*) and some 14 other species being known vectors. Today the question as to the existence of some other insect vector is still asked and still unanswered.

The virus of yellow fever is present in the blood of an infected person throughout the first 4 days of the disease and possibly throughout the incubation period, which averages from 2 to 5 days with a maximum of 6 days. The virus can penetrate the unbroken skin, making direct infection from the blood or organs at autopsy a tragic possibility. After biting an infected person, the mosquito (and only the female of the species is carnivorous, equipped with a proboscis sharp and strong enough to puncture the human skin) does not become infective until the lapse of the "extrinsic incubation period" of 12 days.

The *Aedes aegypti* is one very domestic in habit, living about houses and preferring to lay its eggs in protected receptacles such as tubs, rain barrels, broken bottles, small puddles, where they will be safe from the faster swimming larvae of other insects, and from other fauna naturally inhabitant in unprotected waters. The mosquito does not travel far, is not migratory, and the female's life span is probably a month, possibly 2 or even 3, though the male lives only a few days (2).

The pathological lesions found today in patients killed by yellow fever are identical with those described in earliest colonial days, and there is no difference in the lesions of the jungle yellow fever, nor do the lesions differ in Africa from those in North or South American cases. The characteristic lesions are a midzonal necrosis of the lobules of the liver, a necrosis of the renal epithelium, often with calcification of the desquamated cells, an ecchymosis in various tissues, especially the gastrointestinal mucosa, and jaundice.

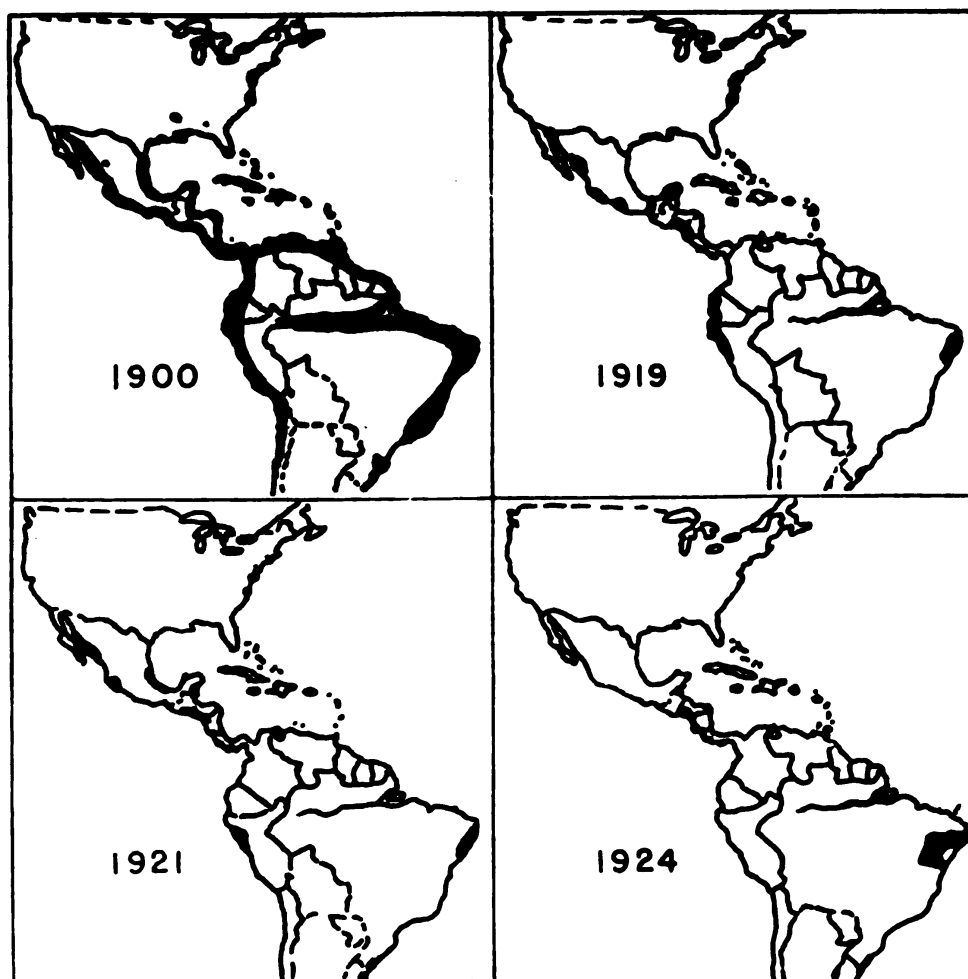
Figure 1 depicts the geographical distribution of yellow fever at different times from 1900 to 1924. At the end of the nineteenth century the distribution took in both sides of the Atlantic between the equator and 20° north. This included the American focus of the shores of the Gulf of Mexico and the Caribbean Sea, and the African littoral on the west, the so-called Gold and Ivory Coasts. Guiteras (3) described three zones:

1. The focal zone, in which the disease was never absent, included Havana, Vera Cruz, Rio de Janeiro, and other South and Central American ports.

2. The perifocal zone, or region of periodic epidemics, which included the ports of the tropical Atlantic in America and Africa.

3. The zone of accidental epidemics between the parallels of 40° north and 45° south.

In America yellow fever has prevailed as far north as Quebec (latitude 40°50') and as far south as Montevideo (latitude 34°54').



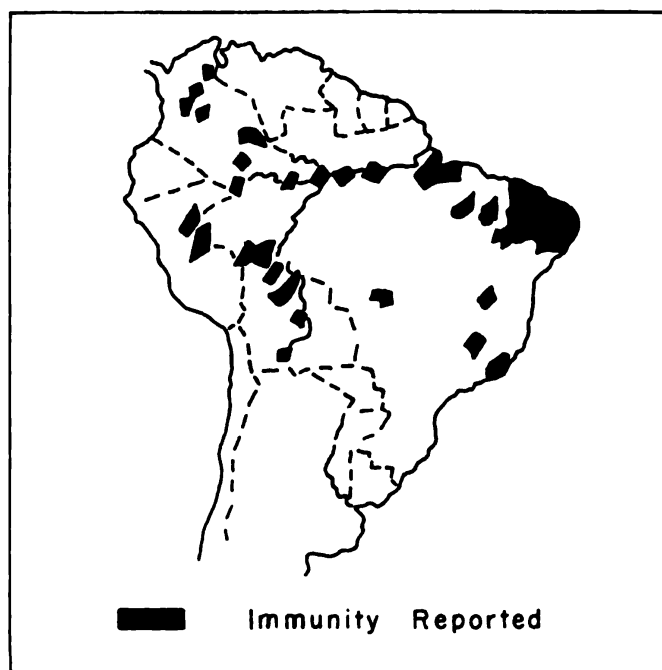
1. MAPS DEPICTING THE GRADUAL ERADICATION OF FOCI OF YELLOW FEVER IN THE WESTERN HEMISPHERE UP TO THE YEAR 1924. (ANNUAL REPORT INT. HEALTH BD. 1924.)

IT IS TO BE NOTED THAT THE LARGE SILENT AREAS OF THE NEW JUNGLE FEVER RECENTLY REVEALED THROUGH THE IMMUNITY SURVEYS AND THE VISCEROTOMY TECHNIC ARE NOT SUSPECTED AT THE TIME OF COMPILATION OF THESE MAPS, AND THE ENDEMIC FOCI ARE LARGELY CONSIDERED TO EXIST ONLY IN THE LARGE TOWNS AND CITIES, ESPECIALLY COASTAL, THE SO-CALLED "KEY CENTERS" FROM WHICH ALL TRANSFER OF YELLOW FEVER WAS PREVIOUSLY SUPPOSED TO TAKE PLACE.

In the eastern hemisphere it occurred as far north as Swansea, and as far south as St. Paul de Loanda in West Africa (90° S.) Its western limits have been the Pacific coast from San Francisco (one case in

1833) to Montevideo. Leghorn, in Italy, marks the easternmost boundary in Europe of yellow fever (longitude E. $70^{\circ}56'$).

Figures 1 and 2 depict the present distribution of the disease. The energetic campaign waged against the spread of the virus has completely freed certain areas previously infected, and the development of a practical method of testing the immunes of any given populace, has made possible the scientific studies of distribution, the results of which are here set forth. This work began in 1927 in West Africa when Stokes, Bauer, and Hudson (4) found that yellow fever was transmissible to certain African monkeys, the *Macacus sinicus* and *rhesus*. In 1930 Theiler (5), by injuring the brain of mice with sterile injections found them susceptible to the virus and determined that infection was aborted if immune serum were mixed with the virus before inoculation. The new tools were immediately used and up to November 1934, sera from some 33,000 persons were examined for their power to protect mice against infection with yellow fever. Immune individuals were found in places where the disease was not believed to exist, and such findings were further substantiated by the use of another new tool, the viscerotome, which permits the taking of small pieces of liver tissue from suspected cadavers without the necessity of complete autopsy. Study of such material showed unmistakable evidence that there were many missed cases of yellow fever, not diagnosed until death.



2. PLACES IN SOUTH AMERICA WHERE YELLOW FEVER IS ENDEMIC, AS DETERMINED BY IMMUNITY TESTS. (SAWYER, W. A.)

In South America it is found through large areas of Brazil especially along the Amazon River; in parts of Colombia, Ecuador, and Venezuela. (Fig. 2.) In Africa it is found along the western coast, the littoral of the Gulf of Guinea from Dakar as far south as St. Paul de Loando, and thence inland some 2,000 miles as far as Tanganyika.

Speaking of the South American distribution in his Harvey lecture given in 1934, Dr. W. A. Sawyer (6) concludes:

* * * that yellow fever has been present in recent years in most of the coastal regions of Brazil from Rio de Janeiro to Para and now is wandering about in the Amazon Valley and in adjacent areas of the Magdalena and Orinoco watersheds, under conditions as yet unknown, and that its range includes parts of Brazil, Colombia, Bolivia, and Peru.

* * * To sum up, there are two vast circumscribed endemic regions of yellow fever, one in Africa and one in South America. Outside of these regions epidemics are very infrequent under present conditions. The regions of endemicity include areas in which the only previously known vector, the mosquito *Aedes aegypti*, is not present, and epidemics have been observed in the absence of the mosquito.

A note of caution is appended in the light of all this against the possibility of the spread of the yellow fever virus to susceptible communities, not only near but far, by modern rapid travel, especially by airplane. Rigid mosquito control must be maintained locally and in such places where the mosquito can flourish, and thorough quarantine programs must be developed in order to prevent the entrance of the infected mosquito or person incubating the infection.

The question of the place of origin of yellow fever has been answered by different authorities in different ways. By some it is placed in Africa—by others in South and Central America, and at least one predicates an Asiatic origin.

Béranger-Féraud and Finlay the elder lead the advocates of an American origin for yellow fever and recently the younger Finlay has gone very thoroughly into the matter and finds much support for his father's views. This group goes back to ancient historical records of the civilizations extant in Mexico before the arrival of Europeans; to the writings of the Spanish historians describing the voyages of Christopher Columbus, and to histories of the early times in the West Indies. They believe that the first instance in history of yellow fever being present in Europeans is found in the descriptions of a scourge, highly fatal, which overtook Columbus and his men after the battle of Vega Real which he fought in March 1494 against some 10,000 Indians. It is reported that the disease affected both Indians and the Spaniards with a loss of about one-third of their number. The younger Finlay (7) says:

Although the mortality was attributed by the Spanish writers to hunger and poor food, both my father and Béranger-Féraud consider that its height strongly

indicates it to have been yellow fever, only four diseases, apart from yellow fever, (typhus, plague, smallpox, and cholera) being capable of producing such a high mortality, none of which can be incriminated, as they would have been recognized by the Europeans.

It seems that the fact that natives as well as the Spaniards were attacked by the disease is against the likelihood of its being yellow fever; but it is of course possible that there were many nonimmunes among the natives of Hispaniola and that the attackers who were mostly from the Spanish Main brought it with them. In the light of the present distribution and endemic silent areas of yellow fever it still seems somewhat improbable that this is the case.

Finlay describes next the similar scourges suffered by later expeditions, with high mortalities, and finds that new colonies settled by those who had survived any of the earlier epidemics, did not suffer any marked losses from the disease. This he attributes to their immunization.

Finlay offers material from the Nahuatl hieroglyphic manuscripts, which covers the period before the conquest of Mexico by the Spaniards in August 1521 but it is unconvincing and Carter (8) in his history of yellow fever avers the same.

He is much more convincing in material which he presents from the ancient Mayan manuscripts, the so-called Chilam-Balam books, rendered into Roman script after the conquest. Finlay the elder received a letter from the very learned Bishop Carillo, of Merida, Yucatan, in which certain passages pertaining to an epidemic suffered by the people are examined and translated. One of these, translated, means, "there was black vomit which began to occasion death among us in 1648." The bishop on further examination found corroborative evidence in another section of the manuscripts which told of the occurrence of the black vomit for the fourth time, and it is speaking of the same epidemic corresponding to the year 1648. Furthermore all records of the Spanish historians from the discovery in 1517 to the year 1648 when the epidemic broke out are alike in agreeing that the Yucatan country was exceedingly healthful, hence the bishop draws the conclusion that since this is so "it must follow that the three previous invasions (of the black vomit) must have occurred before the Discovery."

An accessory statement is also presented, taken from the Mayan manuscripts from the prescription books of the Indians, of which the bishop had several copies in the Mayan language. He says:

In almost all, the following prescription appears: "*U cacel xekik*", this meaning, "for the vomiting of blood", and there is one expressly written in terms which leave no doubts as to whether it applies to any kind of vomiting of blood distinct from the "black vomit" peculiar to yellow fever. This says: "*U calil xekik ti unic, ma hach chachi, maix kaki bay u cab yabacna*", which means

"medicine for the vomiting of blood for persons who discharge it not properly of a red color nor resembling red blood, but like a liquid mixed with soot."

Carter is the leading advocate of the African origin for yellow fever. He questions the Finlay-Béranger-Féraud interpretations of the diseases affecting Columbus' expeditions and of later expeditions to tropical America, explaining these as more probably being malaria, famines, or smallpox.

The historical evidence is meager. There are absolutely no native historical documents to consult, and though there are numerous and good accounts of the voyages of discovery of Italian navigators, they contain practically no data regarding disease. Those who posit an American origin of yellow fever and suppose it was introduced into Africa by the ships trading in slaves, think that if yellow fever were present before this time surely it should have been described by early voyagers. Carter believes this lack less weighty than the positive evidence described above because of the relative richness of historical record in the western world and its absence in Africa. It is admitted that yellow fever occurs in milder form among the blacks and its existence easily passes recognition all too frequently even today when cases are missed completely till the viscerotomy technic reveals the characteristic lesions in the liver.

Carter cites records tending to show the presence of yellow fever in Africa as far back as 1585 when Drake lost 200 or 300 men from a rapidly fatal disease occurring soon after he left the Cape Verde Islands for the West Indies. Carter predicates a greater racial resistance to yellow fever among the negroes even though they are as susceptible as whites. In supporting this contention he tells the story of the half brigade of Kordofan troops sent over to Mexico by Napoleon in 1864. He says, "There had been no yellow fever in Kordofan in historic times, yet these troops enjoyed 'an almost absolute immunity' and suffered no deaths from the disease, while the rest of the expedition, similarly circumstanced, suffered severely" (9).

From a biological point of view the argument is put forward that the reaction of the Negro to yellow fever is what one would expect in a race exposed to a disease for many generations. It is said that the American Indian on the contrary has shown no immunity either to the infection or to the toxins. He contracts it as readily and dies of it as frequently as the white man.

Regarding the known vector, the mosquito (*Aedes aegypti* or one of the 14 other species) could have been transplanted to distant places on sailing vessels where water was kept in kegs on deck, etc., and no matter where the virus existed permanently, at first it would ultimately be transmitted to all other ports with which commerce was carried on, climatic conditions allowing. The *Aedes aegypti*, with its bionomics

peculiar to itself is not considered one of the elder forms by entomologists and is believed to have developed from some similar species with less sharply differentiated characteristics, and that "in the region where this took place one would be able to find a number of forms allied to it but less completely different, those different species of the same subgenus with similar but not quite the same life history. Now no other species of this subgenus (*stegomyia*) is listed as occurring in the Americas * * *. On the other hand, there are many species of *stegomyia* in West Africa and other regions of the Old World, some of them breeding with *aegypti* and with a fairly similar biology. It seems then to be essentially an Old World form that seems to have been evolved there." (7).

The slave trading between Africa and America began in the seventeenth century, and it is known that although the shores of West Africa were visited by Europeans as early as 1364 there is no suggestion of yellow fever occurring. It is not till the seventeenth century that the disease in Africa can be identified with much certainty. Also, modern studies show that several varieties of *Aedes aegypti* have been found in South America, which weakens some of Carter's biological argument. It is left to the reader to conclude as he likes for there does not seem enough actual fact yet found to settle the problem one way or the other.

At all events, in the early part of the seventeenth century it is apparent that yellow fever as a disease entity was recognized and credence is given to the reports of epidemics in the French West Indies in 1648 as being the first that may with certainty be entered as yellow fever. Previous epidemics there had been in these colonies but both Finlay and Carter disbelieve that they were yellow fever because of their low mortality. Du Tertre (10) describes the epidemic thus:

In this same year 1648, the "peste" which up to now was unknown in the islands which had been populated by the French was brought to them by some ships. It began at San Cristobal where in 18 months it destroyed one-third of its inhabitants. This "peste" called "epidemic" produced in those who were attacked a very violent headache, a general lassitude in all their members so that in 3 days men were carried to the tomb. This contagious disease was brought to the Island of Guadaloupe by a ship from La Rochelle called "Le Bouef." * * *

We were only three missionaries left in Guadaloupe to attend to the spiritual necessities of the colonists whose sufferings were incredible during the 20 months that the "peste" lasted. * * *

This quotation is generally considered to be the earliest description we have of yellow fever.

We are now in the first period of the history of yellow fever, that period in which the epidemiological belief was based on the explanations offered during these early days in the West Indies and in the Colonies, and which ended with the publication of the work done by Reed and his associates in Havana in 1900.

In 1649 Cuba was attacked by a scourge brought over from the mainland, and from May to October one-third of the population were killed by a "feverish" disease which destroyed those attacked within 3 days. Undoubtedly yellow fever, the epidemic lasted until 1655. From then to 1751 it probably remained quiescent in unrecognized cases, but in that year Cuba was again visited by a pestilence introduced from Veracruz and known as the "black vomit." Havana's position as an important port of commerce with its constant influx and outflow of strangers contributed to making it a perennial endemic focus until the year 1901, when the disease was finally eradicated by the work of General Gorgas.

Bauer (11) says that according to historical records, it was in 1668 that yellow fever was first seen in North America, at which time both Philadelphia and New York suffered severe epidemics. During the years that followed yellow-fever epidemics occurred from New Hampshire to Florida, in Texas, and as far up the Mississippi River as St. Louis. Philadelphia suffered between 1668 and 1821 from 20 different epidemics of the disease, while in New York it occurred 15 times, 8 times in Boston, and 7 in Baltimore. In Philadelphia in 1793 there were over 4,000 lives taken, and panic seized the city when the presence of the pestilence was officially proclaimed. Business came to a standstill, friends avoided meeting each other, the custom of handshaking was abandoned, and homes were kept locked against the outside world, while others were hurriedly closed as their occupants fled in terror to the country. It must have resembled the days of the Black Plague in Europe, for here, too, we hear the story of burying parties working day and night, plying their gruesomely filled carts incessantly to do away with the deceased. In 1798 another 3,506 deaths were recorded, and by 1870 some 10,000 more lives had been lost.

In New York there occurred up to 1870, 23 epidemics of yellow fever, with a loss of 2,086 in that of 1798.

Spain was a heavy sufferer because of the close commerce she carried on with Cuba, and in 1804 yellow fever epidemics occurred in 25 places with a total population of 427,000, and out of 228,000 cases 52,559 ended in death. One of the outstanding characteristics of yellow fever in these days was its terrific mortality.

And wherever it struck confusion reigned. Nobody knew what caused it, indeed endless arguments among medical men were held on the question whether or not the pestilence was contagious. All that was known were the facts of occurrence in regions where temperature was fairly high, with spread to other places of lower temperatures under favorable circumstances, themselves not understood. It was recognized that when the disease occurred in colder climates it decreased with the advent of colder weather, and with the appearance of frost disappeared entirely. It was noted that infection apparently

did not occur by direct contact with the sick persons, but was suffered by contact with an infected locality, and the disease spread from house to house without any visible or apparent way of transmission.

Meanwhile a Dr. Carlos J. Finlay, a graduate of Jefferson Medical College, was practicing in Havana and devoting time to the study of yellow fever. He had been playing with a telluric theory when the first American Yellow Fever Commission, composed of Drs. Chaillé, Sternberg, and Guiteras, with Dr. Rudolph Matas (then a medical student) as clerk, appeared to study the disease. Finlay was especially impressed, we are told by his son, with the commission's microscopical blood studies, and their final report influenced him no little. It was concluded that "the poison of yellow fever spreads, multiplies, and is endowed with the function of reproduction which is limited to living organisms."

Dr. Finlay continued his studies, and thorough they were. His son (7) tells us of the clues:

A study of Sternberg's collection of microphotographs appeared to him to show that in yellow fever the blood corpuscles of the hemorrhages, which form such a conspicuous feature of the disease, passed undamaged through the unruptured vessel walls. This led him to look for a lesion in the walls, and the transfer of the germ or poison from the interior of the blood vessel of the infective individual to the interior of one of the infected person, and he concluded that an intermediate agent was necessary for the purpose.

Space does not permit the detailed account, fascinating as it is (12), of the researches of this learned Scot. Suffice it to say that in August of the year 1881 Dr. Carlos J. Finlay read before the Academy of Sciences in Havana a most remarkable and exquisitely executed paper in which he proposed that a mosquito, namely the *Culex*, now known as *Aedes aegypti*, was the agent of intermediate transmission in the spread of yellow fever. But nothing happened. For some inexplicable reason this scientific bomb did not explode and not till Finlay's theory was confirmed by the United States Army Commission in 1900 were the first steps taken toward ridding the world of yellow fever. It seems that a word of explanation and of tribute is due, and it is written by Guiteras.

From the epidemiological point of view and with the arguments of the sister sciences, history, geography, meteorology and zoology; studying the geographic distribution of the *Stegomyia* and the influence upon this insect of the variations of temperature and atmospheric pressure demonstrated by most ingenious experiments, Dr. Finlay proved the truth of his doctrine. If he failed to convince us the fault was ours, and not of his prevision.

With the completion of the work of the United States Army Yellow Fever Commission, under Major Reed, and consisting of Drs. Carroll, Agramonte, and Lazear, the *Aedes aegypti* was fixed as the vec-

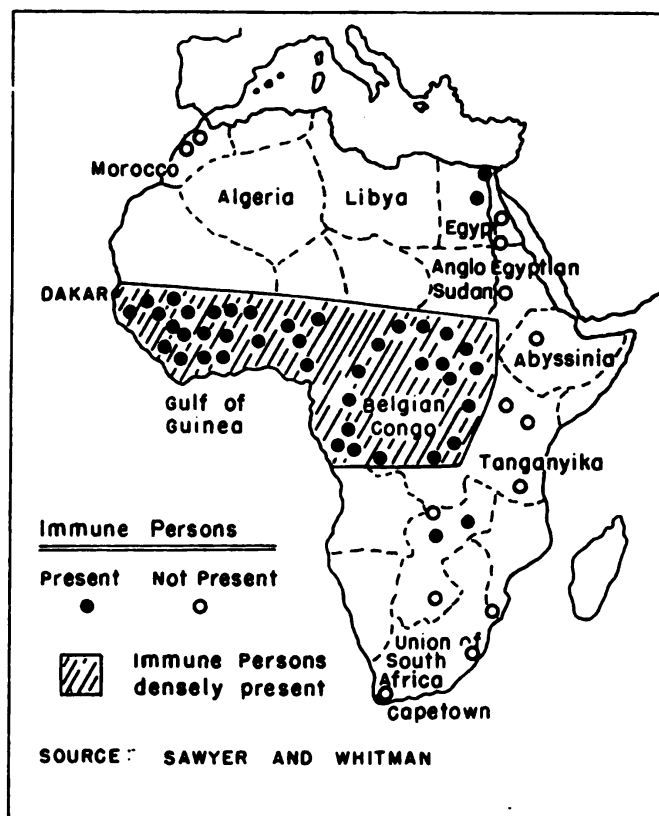
tor, and with the steps taken toward its eradication, yellow fever entered the second period of its history, that characterized by the epidemiological belief that yellow fever is inseparably associated with the *Aedes aegypti* mosquito, and which ended in 1932. The story of the great work of this Yellow Fever Commission under Reed has been too often and too well told to bear repetition here.

The then Major W. C. Gorgas was quick to use the new knowledge, and early in 1901 he headed a vigorous antimosquito campaign in Havana. The results were miraculous, and for the first time since the fifteenth century Cuba was free of the dread pestilence. Three years later a similar work done by Gorgas in the Panama Canal Zone enabled the United States to complete the building of the canal. The measures against the mosquito were carried to other places and in 1905 New Orleans suffered its last epidemic and was as quickly rid of the disease as was Cuba in 1901. This was the last epidemic of yellow fever in the United States.

In 1914 the Rockefeller Foundation entered the field of the study of yellow fever. The previous year had seen the creation of its International Health Commission, which became the International Health Board in 1916 and in 1927 the International Health Division. In August 1914 Mr. Rose, the general director, reported that yellow fever could be eradicated completely, by concentrating effort on the endemic foci. The document (13) was written from the point of view of the then recognized simple epidemiology, that of transmission by the *Aedes* mosquito alone, as its key center theory, and upon this basis the work of the Rockefeller Foundation (and indeed all other agencies), continued till 1930 (14). In 1916 a Yellow Fever Commission was appointed and visited suspected endemic centers in Ecuador, Peru, Colombia, and Venezuela, and later Brazil, including the principal ports from Rio de Janeiro to Para. General Gorgas was appointed director, but the World War in 1917 interfered with the plans.

In 1918 a special commission went to Ecuador to study yellow fever, and among its members was Hideyo Noguchi (19). It was at this time that he announced the isolation from the blood of 6 of 27 yellow fever patients a spirochete which produced in guinea pigs lesions similar to yellow fever and which he called *Leptospira icteroides*. He had great difficulty in transmitting the infection experimentally by the *aedes* mosquito, a fact which prevented some scientists from accepting the *leptospira* as the cause of the disease. However Noguchi's work was generally accepted, and not until 1927, when Sellards (13) found that in an outbreak of fever in Parahyba, Brazil, there was no *L. icteroides*, and Stokes, Bauer, and Hudson (4) in West Africa carried the causa-

tive agent of yellow fever into monkeys and proved it to be a filterable virus, was it disproved. By November in 1918 the planned attack on yellow fever in Guayaquil was started. The mosquito-proofing of water tanks, the placing of larva-eating fish in large water containers and cisterns, and the destruction of mosquito larvae by weekly house inspections were the methods used and the success was as spectacular as previous successes elsewhere. In 1918 there were 460 cases. Since May 1919, there has been no recognized case of yellow fever in Ecuador (14).



3. PLACES IN AFRICA CLASSIFIED ACCORDING TO THE PRESENCE OR ABSENCE OF PERSONS IMMUNE TO YELLOW FEVER, AS DEMONSTRATED BY PROTECTION TESTS IN MICE SURVEYS FROM 1931 TO 1934.

Control operations were also carried on throughout Central America and Mexico and in each place rapid eradication of the disease was always obtained. In 1923 the International Health Board began joint efforts with the Brazilian Government to exterminate it in that country where, despite persistent campaigns the disease still appeared. As Sawyer says, "The results in the principal coast cities were entirely successful, but yellow fever continued to appear in neighboring small communities and even in interior towns. This experience was part of the evidence which revealed the limited application of the key-center theory (14)."

In 1920 a commission sailed from London for Africa but succeeded only in recognizing no authentic cases of yellow fever, so in 1925 another group was sent out. Because only three cases of yellow fever were reported from the Western Hemisphere in that year, personnel and funds were spared for the African investigations. As described above, in 1927 Stokes, Bauer, and Hudson (4) succeeded in transmitting yellow fever to the monkeys *Macacus sinicus* and *rhesus*, and the discovery was confirmed by other workers. Having an experimental animal was of tremendous aid and stimulated a period of most fruitful research. Sawyer, Kitchen, Frobisher, and Lloyd (16) determined that the yellow fever of Africa, of South America, of Panama and other American countries were all the same. Theiler (5) in 1930 found white mice susceptible to yellow fever if inoculated intracerebrally, and Sawyer and Lloyd (17) devised a technic for a mouse protection test; and with the aid of the governments concerned the International Health Division started an immunity survey of the world. The results, explained previously by the maps showing the present distribution of the disease were totally unsuspected and startling. They showed the existence of large so-called silent areas of the disease in the interior of both Africa and South America where the disease had never before been suspected. The situation has been further forwarded by the use of the viscerotome (18).

In summary Sawyer (14) writes:

The newer methods available for epidemiological investigations have produced no results more fundamental to the program of the International Health Division than the observations in South America by Soper and his associates that yellow fever did not disappear in regions in Brazil in which the key centers were kept free from yellow fever for years through intensive mosquito control, and that the infection could maintain itself under forest conditions in the absence of *Aedes aegypti* and in places where there were few people. Under these circumstances the program for banishing yellow fever from the earth through the key-center control obviously had to be given up. The division is now faced with the problem of discovering the vectors and unknown hosts of yellow fever and devising new methods of control. At the same time the spread of the disease from the endemic regions by ships and aeroplanes must be prevented by keeping noninfectible those cities through which the infection would have to pass.

Thus since 1932 yellow fever has been in the third stage of its history, in which it now is and will be until more new facts are garnered. This is the period of jungle yellow fever in which it is known that the disease can exist in the absence of the *Aedes aegypti*, and in the absence of large or changing populations in which the disease may be carried on. As yet the vector of jungle yellow fever is not known. Suppositions as to an agent other than mosquitoes have been made. Also unknown is the answer to the question as to whether or not there exists in the jungle areas a host other than man, in

which yellow fever persists. There are some writers who champion the belief that yellow fever may be primarily an epizootic disease, being widespread among some of the lower animals, and that it may be only secondary in man. If this is so there is no knowledge yet as to what the lower forms are, although recent work suggests that monkeys may play a part.

Jungle yellow fever patients give a life history of living in the jungle regions, that is, in forest areas which were never or only partially cleared for cultivation. It is believed that in Brazil the vector, whatever it is, does not live in the semiarid high plateau lands, but only in the more humid territory along the rivers and in the forests (20).

It is definitely established that the rural areas are not infected from the key-centers, since these are all clean. Probably the reverse is the case. In Brazil three species of monkeys have been found immune to yellow fever, and a long-lived vector such as a tick has been suggested. In Africa less is known.

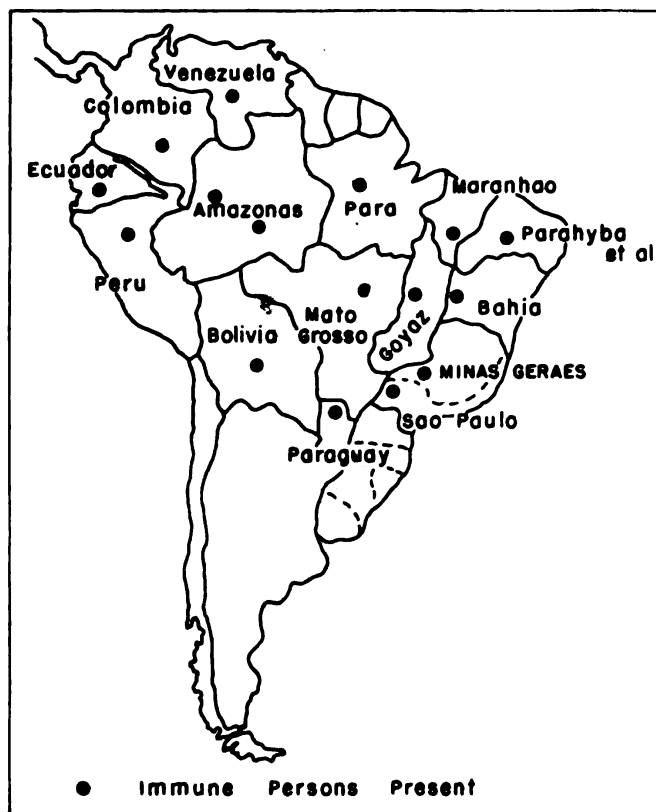
In the course of the discovery of the new aids to research in yellow fever another very practical help was developed in the form of a vaccination which could be used against yellow fever by those working in the field. The work was prompted by the growing list of fatalities in laboratory workers. A method of vaccination consisting of repeated injections of yellow fever immune serum and living yellow fever virus fixed for mice was devised. Tested in monkeys by Sawyer, Kitchen, and Lloyd (28) it was found potent, and starting in May 1931 the vaccination of the yellow fever staff of the Rockefeller Foundation was undertaken. Since then it is reported that there has been not a single case in any member of either the field or laboratory staff. Measured by the mouse protection test the antibodies in the sera of vaccinated persons were found to rise rapidly for a few weeks and then later to descend gradually over a period of years (29). To obviate the use of immune serum, with its entailed expense, a strain of the virus has been modified by tissue culture in the chick embryo, and its neurotropic and viscerotropic properties have been lowered.

With respect to the use of the yellow-fever vaccine an interesting note of caution is written by three Englishmen, Murgatroyd, Findlay, and MacCallum (31) who found that the injection of the yellow-fever vaccine into a patient who had lived in the Tropics evoked an acute exacerbation of a latent type of malaria. They conclude:

A considerable number of patients who are immunized against yellow fever have been already exposed to malarial infection, and it seems probable that vaccination against yellow fever is no more than one of a number of nonspecific factors which may sometimes either precipitate a malarial relapse or permit a latent infection to become manifest.

This possibility must be kept in mind in order that a case of malignant tertian malaria might not be missed, with serious consequences. Any patient from the Tropics who exhibits more than a negligible reaction from the immunization should be immediately investigated.

A summary of the situation at present then devolves principally on the recognition of the new jungle yellow fever, which may be defined



4. SOUTH AMERICA. SHOWING STATES AND SECTORS COVERED BY THE IMMUNITY SURVEY.

as yellow fever which occurs in rural, jungle, or fluvial regions, in the absence of *Aedes aegypti*. The yellow fever transmitted by this mosquito is characteristically a house disease and occurs in any nonimmune persons who may visit infected houses and get stung by an infected mosquito capable of transmitting the virus—that is, by one at the end of the extrinsic incubation period. Jungle yellow fever is not a house disease, but exists in the uncultivated forest lands.

Dr. J. L. Soper, probably the leading authority today on jungle yellow fever has classified the disease as it exists at present and also defined the problems which it presents. First, the classification:

A. Yellow fever with *Aedes aegypti*.

1. Urban yellow fever, of the classic type, occurring in cities, towns, and villages in the presence of *Aedes aegypti* and disappearing when the incidence of the vector is reduced.

2. Rural yellow fever, occurring in strictly rural areas having a high *Aedes aegypti* index, and disappearing when this index is lowered. This type of yellow fever has not been observed in Colombia and had been found only in a section of northeast Brazil, where climatic conditions, including occasional severe droughts necessitating the storage and transport of water by travelers, have greatly facilitated the spread of *Aedes aegypti*.
- B. Yellow fever without *Aedes aegypti*.
1. Rural yellow fever, occurring in strictly rural areas in the absence of *Aedes aegypti* but in the presence of a sufficient density of population to suggest that the cycle of infection may be the simple one, viz., man—vector—man.
 2. Jungle yellow fever, occurring in the absence of *Aedes aegypti* in rural and jungle areas and at isolated points along certain river banks where the density and the movement of human population are so low that the suggestion cannot be avoided that human cases are to a certain extent accidents in an epizootic rather than part of an epidemic limited to humans (7).

There is little doubt that the virus of the two types of yellow fever is the same. For example, laboratory studies have proved that the virus adopted to the *Aedes* is also just as well transmitted by other mosquitoes. In Bolivia, epidemics have been observed as part of the same outbreak with and without the *Aedes*, and finally, cross protection tests of known immune sera with viruses from cases of urban and jungle yellow fever are positive. The clinical courses are the same, as mentioned before, and the pathological picture is essentially the same.

The problems facing the medical world today are put by Soper in the form of questions. He asks:

1. What is the component cycle or cycles, which enable jungle yellow fever to continue in the absence of *Aedes aegypti* and a dense human population, both formerly considered essential to yellow fever endemicity?

This, of course, is the question of what animals exist as reservoirs of the virus, as distinguished from animal hosts subject to infection and capable of developing immunity. It also directs attention to a search for some other vector than the mosquito, probably longer-lived. It may be that yellow fever exists primarily in some lower vertebrate just as bubonic plague exists primarily in the rat and other rodents. There is a partial answer in the evidence suggesting the disease to be one of monkeys, with transmission by some other vector than the mosquito. Practically all South American monkeys, for example, have been found susceptible to yellow fever.

2. Why does the widespread dissemination of jungle yellow fever not result in more frequent outbreaks and in the development of a high percentage of immunes in towns and cities with *Aedes aegypti* throughout the area of jungle endemicity?
3. What control methods can be used to best advantage in prophylaxis of yellow fever: those directed to the reduction of vertebrate hosts, to the

elimination of the invertebrate vectors or to the artificial immunization of the rural and jungle populations of the endemic regions? (7)

It seems that most hope is to be looked for in the direction of the artificial immunization of whole populations, and as intimated above, the recent development of vaccines from tissue cultures of the virus makes such a program appear much more feasible.

Such a paper as this cannot well be ended without note being made of those who have lost their lives while they were advancing the sum of the world's knowledge of yellow fever. Perhaps the list can best be headed with the name of Lazear who died from infection contracted while working with Reed's commission in 1900 in Cuba. Then the name of Hideyo Noguchi whose life was so great an inspiration to scientific research, and those of Adrian Stokes, William Alexander Young, and Theodore B. Hayne. Paul Lewis died in Bahia, Brazil, and Howard B. Cross in Mexico. While investigating the disease in the Tropics, A. Maurice Wakeman, Nelson C. Davis, and Wray Lloyd contracted fatal infections. As Dr. Sawyer (14) points out in tribute, "These pioneering investigators should always be remembered when credit is being given for the advances made in yellow fever research."

SUMMARY

1. Study of yellow fever is most opportune at the present because the disease has only recently entered upon a new period in its epidemiology, invalidating many previous conceptions and much of the technic by which it was hoped that the disease might within our lives be banished from the earth.

2. The question of the origin of yellow fever is unsettled. Perhaps the greater amount of evidence favors its source as being in the American continent, but those who would establish it in Africa believe the less abundant evidence for so doing does not weigh so heavily in view of certain facts which tend to support Africa as the original home of yellow fever.

3. Regardless of the source of yellow fever, by 1648 the disease is well enough described in the French West Indies as to leave little doubt of its validity and recognition. From this time until 1901 is the extent of the first period of epidemiological belief regarding the disease, and during these years numerous epidemics throughout South and Central America, the West Indies, Mexico, and the American Colonies, and then the United States took a tremendous toll in lives.

4. The second period in the history of yellow fever, 1901-32 began with the confirmation of the fact, first worked out by Finlay, that the disease is transmitted by a mosquito, namely, the *Aedes aegypti*. This period sees the great work done in cleaning up most of the previously

endemic foci, much of the work being done by the Rockefeller Foundation working on the "key-center theory."

5. The third and present period in the history of yellow fever may be said to have begun around 1932 with the gradual recognition that there exists a previously unknown type of yellow fever which is called jungle yellow fever, and is not dependent upon the *Aedes aegypti* for transmission, nor upon the presence of a large urban population.

6. The problems now prevalent concerning yellow fever and the steps to be taken in continued work are discussed.

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CONFERENCE OF VENEREAL DISEASE CONTROL OFFICERS¹

By JOHN F. SHRONTS, Lieutenant, Medical Corps, United States Naval Reserve

A 3-day conference of district venereal disease control officers was held in Washington, November 16, 17, and 18, 1942, at the request of the Surgeon General. This conference was the first of its kind to be held for consultation and instruction of naval venereal disease control officers. All naval districts of the continental United States and the Caribbean area were represented.

On the first day of the conference a meeting with the Surgeon General and officers attached to the Division of Preventive Medicine of the Bureau provided an opportunity for the venereal disease control officers to discuss administrative problems.

During the second day of the conference the officers visited a meeting of the Interdepartmental Committee on Venereal Diseases, Office of Defense Health and Welfare Services, Washington. Under consideration were the broader aspects of the venereal disease control program and their relationships to control measures of the Army and Navy. The cooperation existing between the Army, Navy, Department of State, Federal Bureau of Investigation, United Service Or-

¹ Received for publication December 26, 1942.

ganizations, Public Health Service, Defense Health and Welfare Service, and American Social Hygiene Association was exemplified by the discussion among representatives of these agencies and organizations.

The conference was continued in Baltimore, where the members were the guests of the Johns Hopkins School of Hygiene and of Johns Hopkins Hospital. A meeting was held with the class of Army and Navy officers in training for venereal-disease-control assignments, and the discussion was led by Rear Admiral C. S. Stephenson (MC), U. S. Navy; Passed Assistant Surgeon Harry Eagle, U. S. Public Health Service; Dr. Justina Hill, Johns Hopkins University Hospital; Major Gaylord Anderson, Medical Corps, A. U. S.; Lieutenant Frank Reynolds (MC), USNR; and Ensign Howard Ennes, H-V (S), USNR. Topics under consideration were recent findings in the chemotherapy of gonorrhea, gonorrhea in experimental animals, venereal disease prophylaxis, and educational measures.

Following a suggestion of the Surgeon General, the conference officers met in formal session on November 18 to consider ways and means of strengthening the venereal disease control program and to prepare a set of resolutions for the information and guidance of the Bureau of Medicine and Surgery. Commander R. B. Henry, (MC) U. S. Navy (Ret.), venereal disease control officer of the Fifth Naval District, presided, and the following resolutions were prepared:

1. That copies of the venereal disease contact report be sent to the health officer of the place of origin (place of contact named by patient) and to the district venereal disease control officer.
2. That the laws imposing penalties of time and pay in connection with the contraction of venereal disease be repealed.
3. That an improved prophylactic packet be devised and placed on the supply table.
4. That rubber protective sheaths be placed on the supply table.
5. That medical officers serving at recruiting stations instruct the recruits on the dangers of venereal disease and on the protective measures available, furnishing them with printed instructions on the subject and informing them that prophylactic equipment will be furnished on request.
6. That when feasible, prophylactic stations be operated in conjunction with the other branches of the armed services and with the local health authorities, for use by the public and by the members of the armed forces.
7. That adequate detention facilities be provided for women undergoing observation and treatment for venereal disease.
8. That the Bureau of Medicine and Surgery issue monthly reports of the venereal incidence rates of the several naval districts.
9. That a conference of district venereal disease control officers be held in Washington twice yearly.
10. That training of venereal disease control personnel be continued to keep pace with the growth of the Navy.
11. That assistants to district venereal disease control officers be appointed as required, and for training purposes,

12. That particular care be taken in selecting officers for training in venereal-disease control, giving special consideration to the questions of judgment, ability to work with others, experience in treating venereal diseases or in public health work, and a record of successful achievement in the past.

13. That instruction in the principles of venereal-disease control be given at all Hospital Corps schools.

14. That each medical officer be furnished with a manual of instruction in venereal-disease control.

15. That the policy of repression of prostitution be considered sound and should be adhered to.

16. That the distinction between measures for the treatment of venereal disease, and police measures for the enforcement of the laws against prostitution, be clearly maintained at all times.

17. That venereal-disease cases be handled solely as cases of disease with a public health angle and by medical men; that violations of the laws against prostitution, by persons receiving the earnings of prostitutes, and parties to these, be treated as criminal offenses and that a study be made of the feasibility of placing all prostitutes and persons accused of prostitution, in the custody of a board of medical and welfare experts for observation, care, rehabilitation, or other disposition.

18. That definite information be furnished regarding the relationship of venereal disease control officers and the shore patrol.

19. That the status of venereal disease control officers with reference to their jurisdiction over venereal disease control program at air stations be defined.

20. That a statement of policy concerning a venereal disease program among the WAVES be furnished.

21. That provision be made for more effective venereal disease control measures among crews of patrol craft, armed guard, and escort vessels.

22. That a warrant or commissioned rank be established to permit the entry into service of trained epidemiologists with proper educational background, to aid in the venereal-disease program.

23. That a central agency be established for the dissemination of information on venereal-disease control.

24. That representatives of the venereal disease control section of the Bureau of Medicine and Surgery visit the different areas periodically to confer with the venereal disease control officers.

25. That the travel of all venereal disease control officers be facilitated by the issue of travel orders or the furnishing of the necessary transportation and expenses.

It is the judgment of this conference that the results which have already been attained under the venereal disease control program of the Medical Department of the Navy constitute an advance of major importance in the fields of naval medicine and public health and that this work should be continued and expanded.

A second round table discussion was held with the Surgeon General when the resolutions were presented. The Surgeon General stressed the practicality and need for adoption of the resolutions. It is noteworthy that action has already been taken to put some of these into effect.

The conference proved to be a stimulating and instructive experience for the venereal disease control officers. It was the belief of the officers

that the meeting served a definite purpose in further strengthening the Navy's venereal disease control program.



In spite of the many and excellent discussions that have appeared in recent surgical literature with reference to burns it should be emphasized again that burns are large open wounds, and the same principles of treatment apply that have been stressed in the general treatment of wounds—conversion of the contaminated wound into a clean wound, application of an occlusive dressing that provides pressure, and provision for complete rest of the injured part. * * *

A primary consideration is conversion of the contaminated wound into a clean wound by the simplest method that does not add further contamination and further injury. That method, in our minds, is not with the aid of chemicals but with simple, nontraumatizing soap and water cleansing carried out with cleanly surgical technique. When it has been accomplished, and loose destroyed tissue lifted or cut away with sterile instruments, the open wound is covered with a nonadherent dressing, such as a single layer of fine meshed gauze saturated with vaseline, that does not fix or coagulate tissue and that, although nonadherent, permits the escape into the outer covering dressing of the exudate, the "white hemorrhage," that escapes from the burned surface until it is arrested by pressure. Compression is provided by sterile gauze, and by mechanics' waste or sea sponges outside the sterile gauze bandaged under moderate tension, preferably with an elastic bandage such as a stockinet. Not only does such compression arrest escape of plasma from the surface, but it checks the escape of serum into the cellular tissue underneath the surface and helps to limit the vital loss of fluid into the deeper tissues that is such an important factor in the production of shock.

The advantages of such a method of treatment are many: (1) It is simple and concluded in one stage. After the dressing is applied a splint is added, if the burn involves an extremity, and the patient left alone. (2) The chances of adding further contamination are reduced to a minimum. (3) The deeper layers of the skin, if still present to furnish a source for regeneration of the skin covering, are not fixed by a chemical coagulant. Expressed a little differently, if only a thin layer of the corium or dermis is left undestroyed by the original injury the few remaining epithelial elements which might furnish a source for reformation of the covering skin are not rendered inert by application of a chemical coagulant. (4) If the effort to convert the contaminated wound into a clean wound is unsuccessful and infection develops, removal of the dressing to permit recognition of the affected area is a simple procedure. The difficulty of recognizing the exact site of infection under an extensive coagulum and of gaining access to it has disturbed many a surgeon in the care of a severely burned patient. (5) The advantage of providing adequate pressure over the affected area and at the earliest possible moment has been emphasized. A coagulant crust cannot provide the same degree of pressure nor provide pressure promptly. —Koch, Sumner L.: *Injuries of the parietes and extremities*. Surg., Gynec. & Obst. 76: 189-195, February 1943.

STATISTICS

HEALTH OF THE NAVY

The statistics (annual rates per 1,000) appearing in this summary were compiled from data contained in monthly reports of communicable diseases received in the Bureau for the months of July, August, and September 1942.

ENTIRE NAVY

Year	All diseases	Injuries and poisonings	All causes	Communicable diseases		Venereal diseases
				A	B	
1937.....	377	61	439	20	101	59
1938.....	332	57	389	7	72	81
1939.....	325	52	377	3	59	93
1940.....	386	50	436	16	104	82
1941.....	338	48	386	15	82	51
1942.....	341	54	395	36	110	37

FORCES ASHORE

1937.....	508	64	571	31	168	37
1938.....	342	52	394	10	92	39
1939.....	330	50	380	2	78	48
1940.....	367	50	417	13	114	51
1941.....	352	49	401	22	95	31
1942.....	344	47	390	14	116	26

FORCES AFLOAT

1937.....	302	60	362	13	63	72
1938.....	327	60	387	5	60	105
1939.....	322	54	376	4	49	117
1940.....	403	50	453	19	96	108
1941.....	324	48	372	9	70	72
1942.....	333	73	406	9	92	66

DISEASES CAUSING SURVEY

The following table was prepared from reports of medical surveys received in the Bureau during July, August, and September 1942 in which disabilities or disease causing the survey were noted existing

prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office:

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Abscess, periapical	8	Cardiac arrhythmia, auricular fibrillation	2
Absence, acquired, stomach, partial	1	Cardiac arrhythmia, paroxysmal tachycardia	2
Absence, acquired, teeth	27	Cardiac arrhythmia, premature contractions	1
Absence, acquired, toe	3	Cardiospasm	3
Absence, congenital, soft palate	1	Caries, teeth	46
Accessory rib	2	Cataract	8
Acne necrotica, scalp	1	Cataract, traumatic	2
Acne vulgaris	3	Cerebrospinal syphilis, undifferentiated	10
Adamantinoma	1	Cholecystitis, chronic	1
Adenocarcinoma	1	Cholelithiasis	3
Adhesions, abdominal	1	Chorea	2
Adhesions, flexor tendons	1	Chorioretinitis	12
Adhesions, intestinal	2	Choroiditis	7
Adhesions, periduodenal	1	Cicatrix, skin	13
Adhesions, perinephritic	1	Cirrhosis, liver, atrophic	1
Air sickness	3	Colitis, ulcerative	9
Albuminuria	20	Color blindness	65
Alcoholism, chronic	36	Constitutional psychopathic inferiority with psychosis	1
Allergy	5	Constitutional psychopathic inferiority without psychosis	112
Amblyopia	187	Constitutional psychopathic state, criminalism	2
Amnesia	3	Constitutional psychopathic state, emotional instability	201
Amputation, traumatic	4	Constitutional psychopathic state, inadequate personality	153
Aneurysm	1	Constitutional psychopathic state, paranoid personality	13
Angina pectoris	5	Constitutional psychopathic state, sexual psychopathy	16
Angioneurotic edema	2	Contracture	3
Ankylosis	7	Contusion, abdomen	2
Anthraxis	1	Coronary heart disease, arteriosclerotic	7
Aphakia	2	Coxa vara	2
Appendicitis, chronic	2	Cramp, muscle	1
Arteriosclerosis, cerebral	4	Cryptorchidism	20
Arteriosclerosis, general	2	Curvature, spine	14
Arteriosclerosis, local	2	Cyst, teratoma, quiescent	3
Arthritis, acute	3	Cystitis, chronic	1
Arthritis, chronic	110	Dacryocystitis	2
Arthritis deformans	1	Deafness, bilateral	41
Asthma	108	Deafness due to heavy firing	1
Astigmatism, compound hyperopic	11	Deafness, unilateral	19
Astigmatism, compound myopic	41	Defective physical development	3
Astigmatism, simple hyperopic	1	Deformity, acquired	94
Astigmatism, simple myopic	3	Deformity, congenital	74
Astigmatism, mixed	3	Dermatitis	5
Atelectasis	1	Dementia paralytica	3
Atony, bladder	2	Dementia praecox	183
Atrophy, legs	16		
Bronchiectasis	18		
Bronchitis, chronic	9		
Burn	1		
Bursitis, chronic	9		
Calculus, kidney	10		
Calculus, urethral	1		
Carcinoma, rectum	1		

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Detachment, retina	1	Herpes zoster	1
Deviation, nasal septum	1	Hodgkin's disease	3
Diabetes mellitus	34	Hydrocele	1
Dislocation, articular cartilage	13	Hydrocele, tunica vaginalis	4
Dislocation, chronic, recurrent	13	Hydronephrosis	7
Dislocation, joint	9	Hyperchlorhydria	1
Diverticulum, duodenum	1	Hyperopia	2
Duodenitis	9	Hypertension, arterial	54
Dyspituitarism	1	Hypertension, heart disease	4
Dysentery, amebic	1	Hyperthyroidism	3
Dystrophy, progressive	4	Hypertrophy	2
Eczema	8	Hyperventilation syndrome	1
Effort syndrome	9	Hypobaropathy	1
Elephantiasis, nonfilarial	1	Hypochondriasis	1
Emphysema, pulmonary	2	Hypomanic state	1
Encephalitis, chronic	2	Hypopituitarism	1
Encephalitis, lethargic	3	Hypoplasia, congenital	1
Endarteritis	1	Hypospadias	1
Endocrinopathy, adiposogenital	1	Hypothyroidism	2
Endocrinopathy, hypopituitarism	1	Incontinence, urine	1
Enuresis	79	Injuries, multiple	1
Epilepsy	203	Insomnia	1
Epilepsy, Jacksonian	2	Insufficiency, ocular muscle	3
Epiphysitis	3	Intracranial injury (old)	24
Erratic depth perception	1	Iridocyclitis	1
Erythromelalgia	1	Irritable colon	3
Fibrositis	1	Jaundice, hemolytic	1
Fistula	2	Joint, internal derangement of	74
Fistula in ano	1	Keratitis	1
Flat foot	155	Keratoconus	1
Foreign body, traumatic	1	Loss of substance of bone	3
Fracture, compound	1	Lymphogranuloma venereum	3
Fracture, simple	19	Lymphoma, mediastinal	3
Fungus infection, skin	3	Lymphosarcoma	1
Gastritis, chronic	13	Malocclusion, teeth	6
Gastroduodenitis	1	Mastoiditis, chronic	4
Genu recurvatum	2	Masturbation	2
Genu valgum	2	Mediastinal tumor	2
Glaucoma	3	Ménière's disease	2
Goiter, exophthalmic	4	Mental deficiency, moron	10
Gout, acute	1	Metatarsalgia	4
Gout, chronic	1	Migraine	19
Hallux valgus	3	Myasthenia gravis	1
Hammertoe	1	Myocarditis, chronic	1
Hay fever	2	Myopia	39
Headache	22	Myositis, chronic	46
Heart disease, congenital	9	Myotonia, congenita	1
Hemangioma	1	Narcolepsy	3
Hematemesis	1	Nephritis, chronic	13
Hemiplegia, old	1	Nephroptosis	5
Hemorrhoids	4	Neuritis, cervical	1
Hepatitis, chronic	1	Neuritis, multiple	2
Hernia, femoral	1	Neuritis, optic	2
Hernia, inguinal, direct	8	Neuritis, sciatic	17
Hernia, inguinal, indirect	72	Neurofibromatosis	1
Hernia, ventral	9	Neuroma	2
Hernia, diaphragmatic	2	Neurosis, gastric	1
Hernia, muscle	3	Neurosis, intestinal	92
Hernia, recurrent, after operation	7	Neurosyphilis, serological	1
		Nonunion, spinal graft	1
		Nostalgia	3

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Nystagmus	3	Psychosis with other disabilities (mental deficiency)	9
Obesity	2	Psychosis with psychopathic personality	1
Obstruction, intestinal	3	Pyelitis, chronic	2
Opacity, cornea	2	Pyelonephritis	1
Osgood-Schlatter disease	3	Pylorospasm	3
Ossification	1	Raynaud's disease	2
Osteitis, fibrosa cystica	1	Retinitis	1
Osteoarthropathy, hypertrophic	2	Rheumatic fever	14
Osteochondritis deformans	3	Rheumatism, muscular	7
Osteochondritis dissecans	4	Rhinitis, atrophic	1
Osteochondroma	11	Rupture, traumatic	5
Osteochondromatosis	1	Rupture, nontraumatic	2
Osteoma	1	Schizoid personality	1
Osteomyelitis, chronic	20	Sclerosis, multiple	4
Otitis media, chronic	168	Seasickness	3
Otosclerosis	2	Senility	1
Ozena	4	Sexual perversion	18
Pansinusitis	8	Silicosis	2
Paradentosis	36	Simple adult maladjustment	1
Paralysis agitans	2	Sinusitis, ethmoidal	1
Paralysis, nerve	7	Sinusitis, frontal	2
Paralysis, ocular muscle	2	Sinusitis, maxillary	6
Perforated nasal septum	6	Somnambulism	19
Pes cavus	9	Splanchnoptosis	1
Phlebitis	9	Spondylitis	10
Pleurisy, fibrinous, chronic	27	Spondylolisthesis	2
Pleurisy, serofibrinous	4	Sprain	26
Pneumoconiosis	1	Spur, bone	4
Pneumonitis, chronic, nontuberculous	12	Strabismus	25
Pneumothorax	5	Strain	10
Poisoning, chronic, lead	1	Stricture, esophagus	1
Poliomyelitis, anterior, chronic	2	Stricture, urethra	5
Polycythemia vera	1	Sycosis	2
Polypus, nasal	2	Syncope	13
Porencephalia	1	Synovitis, chronic	8
Prostatitis, chronic, nonvenereal	1	Synovitis, traumatic	1
Protruded intervertebral disc	1	Syphilis	48
Pruritis ani	1	Syphilis, seropositive only	9
Psoriasis	2	Tachycardia	8
Psychoneurosis, anxiety neurosis	47	Talipes	7
Psychoneurosis, compulsion neurosis	3	Tenosynovitis, chronic	4
Psychoneurosis, hysteria	71	Thrombo-angiitis obliterans	3
Psychoneurosis, neurasthenia	92	Thrombosis	3
Psychoneurosis, psychasthenia	8	Tooth, impacted	1
Psychoneurosis, reactive depression	1	Trachoma	1
Psychoneurosis, situational	9	Tuberculosis, pulmonary	1
Psychoneurosis, traumatic	13	Tuberculosis, pulmonary, chronic, active, advanced	108
Psychoneurosis, unclassified	20	Tuberculosis, pulmonary, chronic, arrested	275
Psychoneurosis, war neurosis	1	Tuberculosis, pulmonary, primary, healed	98
Psychosis, epileptic	3	Tumor, mixed, benign	4
Psychosis, intoxication, alcohol	1	Ulcer, cornea	3
Psychosis, manic-depressive	39	Ulcer, duodenum	137
Psychosis, unclassified	17	Ulcer, jejunal	1
Psychosis with organic brain disease	1	Ulcer, stomach	10
		Ulcer, vocal cord	1
		Urticaria	3

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Union of fracture, faulty.....	40	Varicocele.....	2
Uveitis.....	1	Varicose veins.....	18
Valvular heart disease, aortic and mitral.....	12	Verruca acuminata, nonvenereal.....	1
Valvular heart disease, aortic insufficiency.....	9	Vertigo.....	4
Valvular heart disease, mitral insufficiency.....	51	Wound, gunshot.....	2
Valvular heart disease, mitral stenosis.....	34	Xanthoma, scalp.....	1
Valvular heart disease, plumedonic.....	1		
		Total.....	4, 861

NOTES ON OUR RESERVE CONTRIBUTORS

Billig, H. E., Jr., Lieutenant (MC), USNR (*A New Aspect of Muscle Reinnervation, a Preliminary Report*, p. 410). A. B., Stanford University, 1928; M. D., Stanford University Medical School, 1932. Assistant in pathology, Stanford Medical School, 1932-33; assistant in orthopedic surgery to Dr. Fred Albee, and resident surgeon Florida Medical Center, 1933-34; orthopedist, Long Island College Hospital, 1934; Harvard University Post Graduate Medical School, orthopedic surgery appointment at Massachusetts General Hospital and Childrens' Hospital, Boston, Mass., 1934-36; private practice, orthopedic surgery, Los Angeles, 1936-41; clinical research in growth and development, Marion Davies Clinic, West Los Angeles, Calif., 1937-; research in nerve muscle physiology, California Institute of Technology, Pasadena, Calif., 1939-; special orthopedist, Women's Student Health Service, University of California at Los Angeles, 1940-; advisory orthopedist for installing system of correction of postural defect causing dysmenorrhea at Health Service Section, Los Angeles city school system, 1942.

Boudry, M. O., Lieutenant Commander (MC), USNR (*An Inexpensive Solution for Skin Sterilization*, p. 533). B. S., University of Wisconsin, 1927; M. D., University of Illinois Medical School, 1929; M.S., Mayo Clinic, 1933. City physician and health officer, Fond du Lac, Wis., 1933-36; private practice, 1936-42. Member county and State medical societies.

Brines, Osborne A., Commander (MC), USNR (*An Experimental Study of Underwater Concussion*, p. 339). B. S., University of Michigan, 1915; M. D., Detroit College of Medicine and Surgery (Wayne University), 1927. Pathologist, Receiving Hospital, Detroit, 1927-; attending pathologist, Eloise Hospital, Eloise, Mich.; pathologist, Alexander Blain Hospital, Detroit; assistant professor of pathology, Wayne University. Member, American Medical Association; American College of Physicians; American Association of Pathology and Bacteriology; American Society of Clinical Pathologists.

Brown, R. B., Lieutenant Commander (MC), USNR (*Observations on the Treatment of Battle Wounds Aboard a Hospital Ship*, p. 299). B. S., Allegheny College, 1929; M. D., University of Pennsylvania, 1933. Instructor in surgery, University of Pennsylvania Medical School; fellow, Harrison Department of Research Surgery. Member, Philadelphia Physiological Society; Philadelphia County and Pennsylvania State Medical Societies.

Corey, Edward L., Lieutenant, H.-V (S), USNR (*An Experimental Study of Underwater Concussion*, p. 339). A. B., Western Reserve University, 1924; Ph. D., Yale University, 1928. Assistant professor, physiology, School of Medicine, University of Virginia, 1929-42. Member, American Physiological Society; American Association of Anatomists; American Society of Zoologists; Society of Experimental Biology and Medicine; Fellow, American Association for the Advancement of Science.

Crile, George, Jr., Lieutenant (MC), USNR (*Experiences of the Surgical Service of the U. S. Naval Hospital, Auckland, New Zealand, with Casualties from the Initial Solomon Islands Engagement*, p. 306). M. D., Harvard Medical School, 1933. Fellow in surgery, Cleveland Clinic Hospital, 1934-36; resident, gynecology, Roosevelt Hospital, New York City, January 1937-June 1937; resident, Cleveland Clinic Hospital, July 1937-November 1937. Private practice, Cleveland, Ohio, 1935-. Member, Cleveland Academy of Medicine; Cleveland Medical Library Association; American Medical Association; American College of Surgeons; American Board of Surgery; American Association for the Study of Goiter; Ohio State Medical Association.

Ecklund, A. M., Lieutenant Commander (MC), USNR (*Experimental Immersion Blast Injury*, p. 353). M. D., St. Louis College of Physicians and Surgeons, 1922. Private practice, St. Louis, Mo., 1923-28; director pathological laboratory of Kauai Medical Society; pathologist Mahelona Hospital, Kauai Plantation Hospitals, and Wilcox Hospital, Kauai; bacteriologist Board of Health, Kauai. St. Louis Medical Society; American Medical Association; American Society of Tropical Medicine; American Public Health Association.

Engelfried, J. J., Lieutenant H-V (S), USNR (*An Apparatus for Testing the Bacterial Filtering Efficiency of Cloth or Similar Material*, p. 521; *A Study of Surgical Masks*, p. 524). A. B., B. S., M. S. P. H., D. P. H., University of Michigan. Instructor, Department of Pediatrics and Infectious Diseases, University of Michigan Medical School, 1934-41. Member Michigan Pediatrics Society; Michigan Academy of Science, Arts and Letters; American Association for the Advancement of Science; American Public Health Association.

Ferguson, L. Kraeer, Commander (MC), USNR (*Observations on the Treatment of Battle Wounds Aboard a Hospital Ship*, p. 299). M. D., University of Pennsylvania Medical School, 1923. Fellow in surgery, University of Pennsylvania Hospital, 1923-25; year's study in Europe, 1928-29. Private practice, Philadelphia, 1925-. Assistant surgeon, University Hospital, Philadelphia; assistant professor, University of Pennsylvania; surgeon, Student Health Service, University of Pennsylvania; chief of the proctologic clinics, Hospital of the University of Pennsylvania and Philadelphia General Hospital; proctologist, Policemen and Firemen of Philadelphia; chief of the industrial clinic, Hospital of the University of Pennsylvania. Member, American Medical Association; American College of Surgeons; Philadelphia Academy of Surgery; American Gastroenterologic Society; Physiological Society, Philadelphia; American Society for Experimental Pathology. Author, *Surgery of the Ambulatory Patient*, 1942; coauthor, *Surgical Nursing*, 6th edition, 1940; surgical editor, *Digest of Treatment*.

Fetter, Ferdinand, Lieutenant Commander (MC), USNR (*Experiences With Fever Therapy at the Philadelphia Naval Hospital*, p. 431). B. S., University of Minnesota, 1926; M. D., 1929. Resident, American Hospital of Paris, 1931; assistant physician, Philadelphia General Hospital, 1932-; assistant physician, Pennsylvania Hospital, Philadelphia, 1937-; assistant physician, Presbyterian Hospital, Philadelphia, 1933-37; associate physician, Presbyterian Hospital, Philadelphia, 1937-; assistant instructor in medicine, University of Pennsylvania School of Medicine, 1933-35; instructor, 1935-41; associate, 1941-. Member, American College of Physicians; American Federation for Clinical Research; American Medical Association; Philadelphia College of Physicians. Certified, American Board of Internal Medicine. Contributor, *Duncan's Diseases of Metabolism*.

- Fleischer, Walter E.**, Lieutenant (MC), USNR (*Lead Hazard Occurring During Repair of a Burned Ship*, p. 386). B. S., Cornell University, 1929; Ph. D., 1933; M. D., 1937. Assistant in physiology, Cornell University, 1930-33; admitting Physician, New York Hospital, June 1937-Jan. 1938; interne, surgery, French Hospital, N. Y., January 1938-July 1939; house surgeon, French Hospital, New York, July 1939-January 1940; ship surgeon for United States Lines, Grace Line and Alcoa Aluminum Line, January 1940-May 1941.
- Friedell, Morris T.**, Lieutenant (MC), USNR (*Experimental Immersion Blast Injury*, p. 353; *Preliminary Appended Report on the Causation of Blast Injury*, p. 363). B. S., M. B., M. D., University of Minnesota; M. S. in surgery, 1940. Fellow in surgery, Mayo Clinic, October 1937-April 1940; first assistant in surgery to Dr. Waltman Walters, April 1, 1940-July 1, 1941. Coauthor (with Dr. Waltman Walters), Stricture of the Bile Duct, in "A Textbook of Surgery," edited by Frederick Christopher, 3d edition, 1942.
- Fulghum, James E.**, Lieutenant Commander (MC), USNR (*Merthiolate-Tannic Acid Method of Treating Abrasion Wounds*, p. 534). B. S. Medicine, Wake Forest College, 1929; M. D., Medical College of Virginia, 1931. Private practice, Louisburg, N. C., 1933-37. Member, Franklin County Medical Society (president); American Medical Association.
- Gerstle, Mark L., Jr.**, Lieutenant Commander (MC), USNR (*The Inapt Naval Recruit*, p. 480). A. B., 1924; M. D., Stanford Medical School, 1925. Assistant, neurology, Stanford Medical School, 1925-28; assistant visiting neurologist, San Francisco Hospital, 1928-28; clinical clerk (under Dr. S. A. Kinnier Wilson), National Hospital, Queen Square, London, February to December 1928; assistant clinical professor, neurology, University of California, 1928-33; visiting neurologist to the French, Mary's Help and San Francisco Hospitals, San Francisco, 1928-33; volunteer assistant in neuropathology, Mount Sinai Hospital, New York City, 1933-38. Fellow American College of Physicians, 1936; member, California Academy of Medicine, 1930; American Medical Association, 1925; associate member, American Psychiatric Association, 1942.
- Good, Harry S.**, Lieutenant (MC), USNR (*Fifteen Days Adrift on a Raft*, p. 367). B. S., Muhlenberg College, 1928; M. D., University of Pennsylvania, 1934. Chief surgical resident, Allentown Hospital, 1935-36; surgical outpatient dispensary, Allentown Hospital, 1936-40; surgeon to Lehigh County Prison, 1936-40; physician for Allentown High School athletic teams, 1939-40. Member, Lehigh County Medical Society; Pennsylvania Medical Society.
- Gunther, Lewis**, Lieutenant Commander (MC), USNR (*Intramuscular Pressure*, VI, p. 414). Junior Certificate, University of California at Los Angeles, 1921; M. D., Yale University School of Medicine, 1926. Attending physician, Los Angeles County Hospital, 1929-37; associate senior physician, Cedars of Lebanon Hospital, Los Angeles, 1942; consulting supervisor, Cedars of Lebanon Medical Clinic, co-chief, cardiology, Mount Sinai Hospital and Clinic, Los Angeles, 1939; consulting physician, University of California at Los Angeles, and attending physician at St. John's Hospital, Santa Monica, Calif., 1942; assistant clinical professor of medicine College of Medical Evangelists, Los Angeles, since 1939. Certified by the American Board of Internal Medicine, 1939. Member, American Medical Association; American Heart Association.
- Harris, Harold J.**, Lieutenant Commander (MC), USNR (*Chronic Brucellosis with Recurrent Iritis, Hemiplegia, and Death from a Complicating Diffuse*

- Encephalitic Encephalomalacia*, p. 517). M. D., Albany Medical College (Union University), 1921. Health officer, Westport, N. Y., 1921-41. Author, *Brucellosis (Undulant Fever)*, Clinical and Subclinical, 1941. Member, Medical Society of the County of Essex; Medical Society of the State of New York; fellow American Medical Association; nonresident fellow, New York Academy of Medicine; fellow American College of Physicians.
- Harris, H. I.**, Lieutenant Commander (MC), USNR (*Psychometric Procedures in the Detection of the Neuropsychiatrically Unfit*, p. 471). B. S. Massachusetts State College, 1927; M. D., Tufts Medical School, 1936. Instructor, Tufts Medical School, 1939-41; assistant, neurology, Harvard Medical School, 1940-41; assistant, neurology, Tufts Medical School, 1939-41; editor, Bulletin New England Medical Center, 1939-41; psychiatrist, Norfolk State Prison Colony, 1940-41; assistant medical director, Joseph H. Pratt Diagnostic Hospital, 1939-41; consultant, neurology and psychiatry, St. John's Hospital, Lowell, Mass. Member American Medical Association; Massachusetts Medical Society.
- Hunt, W. A.**, Lieutenant, H-V(S), USNR (*Psychometric Procedures in the Detection of the Neuropsychiatrically Unfit*, p. 471). A. B., Dartmouth College, 1928; A. M., Harvard, 1929; Ph. D., 1931. Professor, psychology, Wheaton College, 1939-. Fellow American Association for Advancement of Science, member executive committee sect. I; American Psychological Association, member committee on displaced foreign psychologists; Society Experimental Psychologists; American Association of Applied Psychology; American Psychopathological Association. Cooperating editor, *Psychological Bulletin*.
- Jackson, M. M.**, Lieutenant, junior grade, H-V(S), USNR (*Psychometric Procedures in the Detection of the Neuropsychiatrically Unfit*, p. 471). B. A., University of Virginia, 1938; M. A., 1939; Ph. D., 1941. Member So. Society for Philosophy and Psychology; associate American Psychological Association.
- Jones, Benjamin Calloway, Jr.**, Lieutenant (MC), USNR (*Observations on "Catarrhal Fever,"* p. 573). M. D., University of Virginia, 1938. Intern, Cleveland City Hospital, 1938-39; member Lakeside Hospital house staff, Cleveland, as intern for Institute of Pathology; Western Reserve University, 1939-40; assistant resident, internal medicine, Cincinnati General Hospital, 1940-41; physician for personnel of the University of Cincinnati College of Medicine and School of Nursing, 1941.
- Knapp, Arthur A.**, Commander (MC), USNR (*Night Blindness, Improvement with Vitamin D; Including the Experimental Production of Retinitis Pigmentosa and Its Treatment in Humans with Vitamin D*, p. 373). M. D., University and Bellevue Hospital Medical College, 1926. Assistant eye surgeon, New York Eye and Ear Infirmary; research ophthalmologist, Department of Pharmacology, Columbia University, for several projects during 1931-38; assistant visiting eye surgeon and ophthalmologist, Arthritic Clinic, Hospital for Special Surgery (formerly Ruptured and Crippled Hospital); associate ophthalmologist, Montefiore Hospital for Chronic Diseases, 1931-40; director of eye service, Sing Sing Prison Hospital. Fellow American College of Surgeons; member American Medical Association; Association for Research in Ophthalmology; American Academy of Ophthalmology and Oto-Laryngology; New York Academy of Medicine.
- Krueger, Albert P.**, Commander (MC), USNR (*Distribution of Influenzal Antibodies Among Vaccinated and Unvaccinated Naval Personnel*, p. 426). A. B.,

Stanford, 1925; M. D., 1928. Assistant bacteriology and experimental pathology Stanford, 1927-28; acting instructor, 1928-29, instructor and assistant professor, 1929; associate, general physiology, Rockefeller Institute, 1929-31; associate professor, bacteriology, University of California, 1931-, consultant communicable diseases, student health service, and lecturer medicine, medical school, 1932-. Assistant visiting physician University of California Hospital, 1931-, consultant bacteriology, 1932-; professor of bacteriology, University of California, 1938-; grant, cmt. scientific research, American Medical Association, 1938, A. A.; Society of Bacteriologists; Society for Experimental Biology; Society of Experimental Pathology; American Association of Immunologists.

Lodge, Townsend, Lieutenant, H-V (S), USNR (*The Inapt Naval Recruit*, p. 480). B. A., Oberlin College, 1929; M. A., Ohio State University, 1932; Ph. D., Western Reserve University, 1940. Psychologist, Elmira (N. Y.) Reformatory, 1933; research assistant, psychology, Western Reserve University Medical School, 1936-38; psychologist, Cleveland Municipal Court and Cuyahoga County Court of Common Pleas, 1938-41; acting director Cleveland Criminal Court Psychiatric Clinic, 1941. Member American Psychological Association; American Association for Applied Psychology.

Ludwick, J. E., Lieutenant Commander (MC), USNR (*Observations on "Catarrhal Fever,"* p. 573). M. D., University of Michigan, 1922. Undergraduate instructor, physiology, University of Michigan; intern, W. A. Foote Memorial Hospital, Jackson, Mich.; private practice, medicine and surgery, Jackson, Mich., 1923-42; staff member, W. A. Foote Memorial Hospital and Mercy Hospital. Past president Jackson County, Mich., Medical Society; member Michigan State Medical Society, and American Medical Association.

McMaster, Paul E., Lieutenant Commander (MC), USNR (*Muscle Hernia of the Leg*, p. 404). M. D., Rush Medical College, 1928. Assistant and instructor, orthopedic surgery, University of Chicago, 1930-33; instructor and assistant clinical professor, orthopedic surgery, University of Southern California Medical School, 1933-. Diplomate American Board of Orthopedic Surgery, 1938; member American Academy of Orthopedic Surgeons; Western Orthopedic Association.

Nicholson, J. T., Lieutenant Commander (MC), USNR (*Observations on the Treatment of Battle Wounds Aboard a Hospital Ship*, p. 299). B. S., University of Pennsylvania; M. D., University of Pennsylvania, 1928. Internships: Pennsylvania Hospital, 1928-30; Philadelphia Orthopedic Hospital, 1930-32; Philadelphia Shriners Hospital, 1932; Johns Hopkins, 1932; Massachusetts General Hospital, 1933. Private practice, Philadelphia, 1934-. Assistant orthopedic surgeon, Philadelphia Orthopedic Hospital; Graduate Hospital University of Pennsylvania; Philadelphia General Hospital. Consultant, orthopedic surgery: Children's Hospital; Mary Drexel Home. Orthopedic surgeon, Children's Hospital; assistant professor orthopedic surgery, Graduate School of Medicine, University of Pennsylvania. Member, Philadelphia Medical Association; Pennsylvania State Medical Society; American Medical Association; fellow, American College of Surgeons; Philadelphia Orthopedic Society; Academy of Orthopedic Surgeons; American Board of Orthopedic Surgeons; Interurban Orthopedic Society; Philadelphia College of Physicians.

Patterson, J. K., Commander (MC), USNR (*Femoral Vein Ligation for Thrombophlebitis with Pulmonary Embolism*, p. 512.) B. A., Reed College, 1925; M. D., Harvard Medical School, 1929. Diplomate National Board, Internship: Roosevelt Hospital, general surgery, 1930-32; Roosevelt Hospital,

gynecology, 1932-33; Boston Lying-in-Hospital, January 1933-July 1933. Resident, Doctors Hospital, New York, November 1933-July 1935. Staff member, County Hospital, St. Francis and County General Hospital, Santa Barbara. Santa Barbara County Medical Society.

Quinn, Robert W., Lieutenant (MC), USNR (*Spontaneous Rupture of the Right Ventricle*, p. 507). M. D., C. M., McGill University, 1938. Rotating internship, Alameda County Hospital, Alameda, Calif., 1938-39; intern, internal medicine, University of California Hospital, San Francisco, 1939-40; research fellow in medicine, assistant in medicine, University of California Medical School, San Francisco, 1940-41; resident in cardiology and assistant in medicine, Presbyterian Hospital, New York City, 1941.

Rogers, W. L., Lieutenant Commander (MC), USNR (*Os Calcis Fractures in Naval Warfare*, p. 324). A. B., Stanford University, 1923; M. D., Stanford University Medical School, 1926; attended University of Hamburg, 1929-30, and the University of Vienna, 1930-31. Private practice, San Francisco, 1926-; consultant in surgery, Stanford University, 1927-; consultant surgeon, U. S. V. B., 1929-; French Hospital, 1931-; chief of staff, French Hospital, 1939-; consulting surgeon, Southern Pacific Hospital. American Association for Thoracic Surgery; charter member San Francisco Surgical Society; California Academy of Medicine, American Medical Association; American Tuberculosis Association; California State and San Francisco County Medical Societies; vice president of California Trudeau Society.

Sala, Roland O., Lieutenant Commander (MC), USNR (*Diver's Squeeze*, p. 493). M. D., University of Iowa, 1924. Member staff, St. Anthony's Hospital, Rock Island, Ill.; Lutheran Hospital and Moline Public Hospital, Moline, Ill. Member A. M. A.; Illinois State Medical Society; Illinois-Iowa District Medical Association; Association of Military Surgeons.

Shaw, Christopher C., Lieutenant Commander (MC), USNR (*Diver's Squeeze*, p. 493). M. D., Maryland University, 1931. Instructor, pathology, Maryland University, 1932-33; resident, tuberculosis, Baltimore City Hospitals, Baltimore, Md., 1933-34; resident, medicine, Metropolitan Life Insurance Co. Sanatorium, Mount McGregor, N. Y., 1934-35; commonwealth postgraduate medical fellow, Harvard, 1940; attending physician, Community Hospital, Walpole, N. H.; consulting physician, Kurn Hattin Homes, Westminster; visiting physician, Warner Home, Saxton's River. Fellow American College of Physicians; certificate, American Board of Internal Medicine, 1939; charter member, Vermont State Cancer Commission; trustee, Vermont Tuberculosis Association; American Medical Association.

Shronts, John F., Lieutenant (MC), USNR (*Conference of Venereal Disease Control Officers*, p. 593). B. S., Northwestern University, 1930; M. D., Northwestern University Medical School, 1935; M. S. in P. H., University of Michigan, 1938; candidate for Dr. P. H., University of Michigan, 1943. Resident, Lucas County Hospital, Toledo, Ohio, 1937; attending physician, Northwestern University Medical School Clinics, 1939-40; State of Illinois Department of Public Health, 1939-41. American Public Health Association; Illinois Medical Society; Illinois Public Health Association.

Slagle, T. D., Lieutenant Commander (MC), USNR (*Jellyfish Stings, Suggested Treatment, and Report on Two Cases*, p. 497). A. B., University of North Carolina, 1928; M. D., Cornell, 1932. Resident physician, University Hospital, Syracuse, N. Y., 1934-35; assistant resident surgeon, Beekman Street Hospital, July-Dec. 1935; surgical staff Ryder Memorial Hospital, Humacao, P. R., 1936-37.

Private practice, Coamo, P. R., 1937-38; director St. Lukes Hospital, Ponce, P. R., 1938-39; director, Presbyterian Hospital, San Juan, P. R., 1939-42. Diplomate of National Board of Medical Examiners; fellow American College of Surgeons; acting director, blood and plasma bank, School of Tropical Medicine, San Juan, P. R., 1942.

Smiley, Dean F., Lieutenant Commander (MC), USNR (*Staphylococcal Food Poisoning*, p. 565). A. B., Cornell, 1916; M. D., Cornell, 1919. Instructor, hygiene and preventive medicine, and assistant medical adviser, Cornell University, 1920-21; assistant professor, hygiene and preventive medicine, and medical adviser, Cornell University, 1922-28; professor, hygiene and preventive medicine, and health officer, Cornell University, 1929-42. One time field investigator for Carnegie Foundation for the Advancement of Teaching, acting director Division of Health and Physical Education, New York State Department of Education, president of American Student Health Association. Fellow American Public Health Association and former councillor. Author of school and college textbooks in field of hygiene and preventive medicine.

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Hospital, 1935-; associate instructor, orthopedic surgery, Columbia University, 1933-38. New York County and State Medical Societies; American Medical Association; American Rheumatism Association; New York and Brooklyn Regional Fracture Committee; New York Academy of Medicine.

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United States Naval Medical Bulletin

PUBLISHED *for the* INFORMATION OF THE
MEDICAL DEPARTMENT *of the* NAVY

BIMONTHLY



THE MISSION OF THE MEDICAL CORPS OF THE NAVY

•
**TO KEEP AS MANY MEN AT AS MANY GUNS
AS MANY DAYS AS POSSIBLE**

Issued Bimonthly by the Bureau of Medicine and Surgery
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THE MEDICAL DEPARTMENT OF THE NAVY



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NAVY DEPARTMENT,
Washington, March 20, 1907.

THIS UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of professional interest.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T McINTIRE,

Surgeon General, United States Navy.

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have them typewritten.

In submitting articles for publication either in the BULLETIN or in other journal, the author should include a signed statement to the effect that "the opinions or assertions contained therein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large." (Art. 113 (2) U. S. Navy Regulations.) If forwarded for publication in other journal the article must be submitted in duplicate, one copy being retained in the Navy Department files.

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The editor regrets to have to say that reprints of articles can no longer be supplied by the Government Printing Office.

ROBERT C. RANDELL, *Editor,*
Commander, Medical Corps,
United States Naval Reserve.
STEPHEN A. ZIEMAN, *Assistant Editor,*
Lieutenant Commander, Medical Corps,
United States Naval Reserve.

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U. S. NAVAL MEDICAL BULLETIN

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SPECIAL ARTICLES

WAR WOUNDS OF THE PERIPHERAL NERVES ¹

WINCHELL M. CRAIG

Captain (MC) U. S. N. R.

War wounds of the peripheral nerves comprise one of the major problems which the medical officer encounters. The preponderance of injuries to the extremities naturally are associated with a large number of peripheral nerve injuries.

Peacetime injuries of the peripheral nerves are usually clean-cut and without extensive damage to the nerve or the surrounding tissues and thus can be repaired without debridement and without delay. In order that the most satisfactory nerve regeneration take place the severed nerves should be anastomosed without tension, without hemorrhage, and without infection, and relatively soon after the injury has been sustained.

War wounds of the peripheral nerves produced by bullets, shell fragments, and exploding bombs cause extensive destruction of tissue and at a time and place which precludes immediate suture and usually requires excision of varying amounts of injured tissue. By the time these wounds can be cared for, due to delay in transportation, infection may have set in. Thus the problems encountered in the repair of war wounds of the nerves involves secondary or delayed suture, receding nerve ends, damaged portions of the nerve and even large gaps in the nerves which have been blown away.

Much experimental work has been, and is being done to facilitate these problems, such as the effect of the sulfonamides in infected or potentially infected wounds, the efficacy of nerve grafts, the most satisfactory type of nerve suture, the length of time necessary for regeneration and return of function.

ANATOMICAL CONSIDERATION

The peripheral nerves exposed to the majority of war wounds are those supplying the extremities. They arise from the brachial and

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lumbosacral plexuses and injuries to these plexuses may simulate more distal injuries. When examining a patient with neurological evidence of nerve injury this possibility must be kept in mind.

The brachial plexus may be injured by falls upon the shoulder, by wounds of the supra and infraclavicular region and wounds of the shoulder. The brachial plexus is formed by the union of the anterior division of the fifth, sixth, seventh, and eighth cervical nerves and of the first thoracic nerve.

Cervical ribs may cause symptoms referable to the brachial plexus following trauma to the neck and shoulder. The symptoms are due to a compression of the cords of the plexus and the subclavian artery. Thus the symptoms can be divided into the neurogenous and the vascular. Pain is usually present in the ulnar border of the forearm or hand and is increased by movements of the arm. Numbness, tingling, and coldness are usually present, associated with vasomotor changes of cyanosis and edema. The pulse in the radial artery can usually be occluded by movements of the shoulder or extension of the neck. Resection of the scalenus anticus muscle usually is followed by relief but in some of the cases it is necessary to remove the rib.

Since injuries of the brachial plexus resulting from gunshot injuries have a tendency to recover spontaneously, decision with regards to treatment may be delayed. The recovery may be due to the fact that the plexus may not be lacerated but concussed by the force of the bullet or shell fragment, compressed by hemorrhage, or stretched by the trauma. Damage from gunshot wounds is dependent upon the course of the bullet, and the initial laceration and hemorrhage is often followed by secondary changes due to infection and fibrosis, thus confusing the clinical picture.

RADIAL NERVE

Of all the peripheral nerves the musculospiral or radial is the most frequently injured. It derives its fibers from the fifth, sixth, seventh and eighth cervical, and first thoracic nerves and it supplies the triceps and anconeus muscles which are the extensors of the forearm, the supinator longus which supinates and flexes the forearm, and the extensor carpi radialis longus and brevis which extend and abduct the hand. In the hand the extensors digitorum communis, digiti quinti proprius, indicis proprius and pollicis longus are innervated, all of which extend the appropriate digits and when they are fully extended help extend the wrist. The radial supplies the extensor carpi ulnaris which extends and abducts the hand, the extensor pollicis brevis which extends the proximal phalanx of the thumb and the abductor pollicis longus. The sensory branches of the radial nerve supply the radial portion of the dorsum of the hand and fingers except the little finger and the ulnar side of the ring finger.

The radial nerve is frequently injured in the axilla by wounds and dislocations or fractures of the upper part of the humerus or by subsequent formation of callus. Pressure from crutches, sleeping with the head on the arm or pressure during unconsciousness may produce injuries to the nerve.

Lesions of the nerve at different levels produce different disabilities. When the nerve is involved in the axilla all the muscles supplied by the nerve are paralyzed. There will be a paralysis of extensors of the forearm, hand, and the proximal phalanges of the fingers. The elbow cannot be extended, nor can the wrist, thumb, and fingers at the metacarpal phalangeal joints. The arm cannot be supinated when extended. The hand and fingers at rest are in a characteristic flexed and pronated position. The branch to the triceps muscle is given off high in the arm and frequently fractures of the humerus show no involvement of the muscle, and the extensors of the forearm are intact. Isolated paralysis of individual extensor muscles may occur from penetrating wounds of the forearm affecting the dorsal interosseus nerve.

Fractures of the forearm may produce injury to the deep branch of the radial nerve as it passes around the head of the radius causing paralysis of extension of the proximal phalanges of the fingers but does not affect extension of the wrist. The injury is below the level of innervation of the extensor carpi radialis longus and at times below the branches to the other extensors of the wrist as well. Supination is partially preserved even though the supinator muscle is paralyzed due to action of the brachio-radialis and biceps muscles. Wrist drop is the most outstanding disability of the radial nerve and a swelling appears on the dorsum of the wrist due to the slight subluxation of the os magnum or a tenosynovitis of the extensor tendons. Sensory changes are rarely complete in radial nerve injuries because of a large overlap from the adjacent nerves.

The radial nerve in its anatomical distribution is so arranged that it is particularly susceptible to trauma as it winds around the humerus, and consequently is involved in the majority of the fractures of the middle of the humerus. Any fracture of the humerus which is associated with or followed by the clinical symptoms of wrist drop should be suspected of involving the musculospiral nerve. If the wrist drop comes early, the nerve has been damaged at the time of fracture, whereas if the wrist drop develops late, the nerve has become involved in callus formation. Regardless of the cause, the nerve should be explored and if it has been severed an end-to-end anastomosis should be done. If callus formation has involved the nerve, then it should be dissected free and a neurolysis done.

If in the repair of the musculospiral nerve a gap appears, preventing the end-to-end anastomosis, the nerve ends can be more closely approximated by the transposition of the nerve and by flexing the

elbow. Should it be necessary to flex the elbow in order to approximate the nerve ends, the elbow joint should be kept in a position of flexion for a period of at least four weeks after the nerve suture has been made.

THE MEDIAN NERVE

The median nerve arises from the fifth, sixth, seventh and eighth cervical, and first thoracic segments. In the forearm it supplies all the muscles except the flexor carpi ulnaris and the inner half of the flexor digitorum profundus. The nerve supplies the opponens pollicis, flexor pollicis brevis, abductor pollicis, flexor digitorum sublimis, flexor pollicis longus, pronator teres, flexor carpi radialis, pronator quadratus, palmaris longus and the lateral two lumbricales. Thus lesions of the median nerve affect opposition of the thumb to the little finger, flexion of the index and middle fingers, and generally abduction of the thumb. The latter movements are occasionally possible, even with complete median nerve paralysis due to a frequently present anomalous innervation of the flexor pollicis brevis by a twig from the deep branch of the ulnar nerve in the palm. The arm cannot be pronated or the wrist abducted. The nerve may be injured peripherally but also may be involved in luxations of the humerus, by wounds in the upper arm, and by fractures of the humerus or lower arm. Median nerve injuries are followed by a slight deviation of the hand to the ulnar side, absence of flexion of interphalangeal joints, flexion and abduction of the thumb (flat ape hand) and atrophy of the thenar eminence.

The anatomical distribution of the median nerve is such that it is more susceptible to injury in the lower forearm than in any other portion. Most of the median nerve injuries occur at or about the wrist and here again an end-to-end anastomosis is preferable to any other type of nerve suture. Very frequently wide gaps in the nerve can be overcome by extensive dissection of the nerve, particularly in the forearm, without sacrificing any of the smaller branches. Flexion of the wrist quite often allows for close approximation of the divided ends.

The sensory loss in median nerve lesions is particularly severe, involving the palm of the hand on the lateral side, and the volar surfaces of the index, middle and half of the ring fingers. On the dorsal surfaces the median nerve supplies only the skin over the terminal phalanges of the thumb, index, middle and half of the ring fingers.

Median nerve injuries are associated with profound vasomotor and trophic changes giving rise to the condition known as *causalgia*, in which the skin becomes cyanotic, smooth and glossy, and the nails become tough ridges and curl at the ends.

THE ULNAR NERVE

The ulnar nerve arises from the eighth cervical and the first thoracic segments. In the forearm, the nerve supplies the flexor carpi ulnaris which flexes and abducts the wrist, and the inner half of the flexor digitorum profundus which flexes the terminal phalanges of the little and ring fingers. In the hand the nerve supplies the adductor pollicis, the hypothenar muscles (abductor and opponens digiti quinti, flexor digiti quinti brevis) all the interossei and two inner lumbricals.

A complete ulnar nerve lesion results in weakness and radial deviation of the hand during flexion due to paralysis of the flexor carpi ulnaris. The terminal phalanges of the last two fingers cannot be flexed because of the ulnar innervation of the outer portion of the flexor digitorum profundus.

Loss of power of the adductor pollicis muscle prevents adduction of the thumb and accounts for the unusually wide separation of the thumb and index finger. Abductor of the little finger is impossible due to paralysis of the muscles of the hypothenar eminence.

The most disabling feature is loss of function of the interossei and lumbricales. As a result the fingers cannot be adducted and abducted, the proximal phalanges of the last two fingers cannot be flexed nor the terminal phalanges extended. Thus the characteristic *main en griffe* position results from unopposed action of the extensor digitorum communis on the proximal and the long flexor muscles on the terminal phalanges of the little and ring fingers, and to a lesser degree the middle finger. Much atrophy soon becomes apparent along the ulnar aspect of the forearm, the hypothenar area and the interosseous spaces. The latter allows the flexor tendon to stand out as tight bands stretched across the palm.

The area of anesthesia varies according to individual distribution of fibers and degree of cutaneous overlap but generally includes the little finger, ulnar half of the ring finger, as well as the ulnar portion of the palm and dorsum as high as the wrist.

The ulnar nerve as it descends behind the internal condyle is involved in many injuries about the elbow joint. In many fractures about the elbow the ulnar nerve is not only divided but is very apt to be involved in the callus formation of the healing bone. When the ulnar paralysis occurs at some time following the injury it is called tardy ulnar palsy. The procedure indicated in this particular type of disability is neurolysis and the transplantation of the nerve anterior to the internal condyle and beneath the flexor group of muscles. Similar to the median nerve the ulnar nerve is particularly susceptible to all injuries about the wrist. In injuries near the wrist an end-to-end anastomosis can be accomplished by flexing the wrist

and if necessary the proximal portion can be materially lengthened by wide dissection and transference of the nerve anterior to the internal condyle. Should flexion at the elbow and wrist be necessary in order to approximate the divided ends of the nerves, this position should be maintained in both joints over a period of four weeks before gradual extension be allowed.

THE LUMBOSACRAL PLEXUS

The lumbosacral plexus may be involved in wounds of the lower abdomen and the pelvis, producing lesions of the lower extremities. But the majority of the peripheral nerve lesions in the lower extremities occur in wounds and fractures of the legs.

THE SCIATIC NERVE

The sciatic nerve is derived from the anterior primary divisions of the fourth and fifth lumbar and the first, second, and third sacral nerves. The trunk supplies the biceps femoris, semitendinosus and semimembranosus, all the flexors of the lower leg and the adductor magnus. It divides into two large branches in the lower third of the thigh, the tibial or internal popliteal and the common peroneal or external popliteal. Though generally considered as one trunk it actually consists of the tibial and peroneal nerves enclosed in a common sheath.

The sciatic nerve in its distribution through the musculature of the thigh is frequently injured by bullet wounds and shell fragments. More frequently than not it is either partially injured or grazed and the subsequent disability is brought about by hemorrhage into or scar formation about the nerve. Any wound of the sciatic nerve should be explored and in the majority of cases a neurolysis is all that is necessary. Should the nerve be severed, an end-to-end anastomosis is the procedure of choice.

The tibial supplies the gastrocnemius, plantaris, soleus and popliteus muscles. When paralyzed the heel cannot be raised and standing on tiptoe is impossible. Supplied also by this nerve is the tibialis posterior which extends and inverts the foot, and the flexor digitorum longus and flexor hallucis longus which flex the toes and later the foot plantarward. The cutaneous branches of the tibial nerve supply the lateral and posterior part of the lower third of the leg, the skin of the heel, and medial side and medial part of the sole of the foot as well as the lateral part of the sole.

The common peroneal descends from the popliteal space and crosses the upper part of the fibula thus making it vulnerable to wounds and fractures of the fibula as well as compression against the bone. It supplies chiefly the skin of the anterior, and lateral surfaces of the lower leg and the dorsum of the foot. The nerve as it passes beneath the

peroneus longus muscle divides into the deep and superficial peroneal nerves. The former supplies the tibialis anterior, extensor hallucis longus, extensor digitorum longus and the peroneus which are extensors to the foot and the toes. The latter supplies the peroneus longus and brevis muscles.

The external popliteal nerve as it descends from above downward and curves around the upper portion of the fibula may be injured by fractures of the fibula, gunshot wounds of the lower legs, or compression from casts which have been applied too tightly about the knee. The danger signal of foot drop should always suggest injury to this nerve. In the majority of cases following foot drop that portion of the nerve which lies superimposed upon the fibula should be explored. Here again if the nerve is severed, an end-to-end anastomosis should be done, or if the continuity has been preserved and the disability is a result of constriction, neurolysis should be carried out.

STRUCTURE OF THE PERIPHERAL NERVES

Every peripheral nerve is made up of small bundles of individual fibers which are surrounded by a connective tissue sheath called the epineurium which conveys the blood vessels and lymphatics. The connective tissue which surrounds the individual nerve fibers or funiculi, is called the perineurium. A delicate connective tissue, the endoneurium is found between the nerve fibers. The branches of the nerve and the single nerve fibers passing to their distribution are surrounded by a prolongation of the perineural sheath—the sheath of Henle. The nerve trunks are supplied by sensory fibers (nervi nervorum) which ramify chiefly in the epineurium and terminate within this in end bulbs.

The pathological changes which take place in the nerve as a result of trauma play a principal part in the results obtained from nerve repair. Unless these changes are kept in mind in approaching the problem, unsatisfactory results will follow.

As soon as the nerve is severed, two reactions set in—degeneration and regeneration. The changes in the distal and proximal segments are similar. The neurofibrillae break up and become granular and the myelin sheaths become fragmented. The neurilemmal sheaths with their nuclei (Schwann cells) revert to embryonic or active type and begin to proliferate. This is supposed to occur in 24 to 36 hours in the segments nearest the section. The cytoplasm surrounding the nuclei increases during the next 2 days and on the fourth to the sixth day the protoplasmic bands are well developed. Some observers have observed these as late as the twenty-first day. It has been demonstrated that these protoplasmic bands form conduits or pathways down

which the regenerating neurofibrillae grow from the proximal to the distal segment, finally neurotizing the end plate.

The degeneration is complete in the distal segment but in the proximal it only progresses as far as the nearest division or node of Ranvier. Here the degeneration ceases and the regeneration begins. As early as 6 days after the division of the nerve, growing axis cylinders or neurofibrillae may be found in many of the bands a distance of 1 mm. from the extreme end of the proximal stump. This reaction emphasizes the necessity for early repair.

Hyperplasia of the connective tissue elements of the nerve explains the formation of neuromata which are found at secondary or delayed operations. The axis cylinders which regenerate and begin the downward growth are diverted into whorls if there is no continuity provided and these whorls of cellular activity must be resected before a continuity can be established. The successful repair of a nerve depends upon the approximation of the proximal and distal segments to allow the normal process of nerve regeneration.

PHYSIOTHERAPY

During the time that nerve regeneration takes place, the muscles supplied by that nerve should be treated with passive motion and massage. This procedure does not further regeneration, but assists in keeping the muscles in better physical condition and more receptive to the regeneration when it occurs.

METHODS OF REPAIR

Ever since the process of nerve regeneration has been known, many methods of nerve repair have been suggested and carried out both experimentally and clinically. The most baffling problem has been the bridging of gaps in wounds in which a portion of the nerve has been destroyed. Plastic repairs have been attempted and given up because they do not furnish the nerve with a continuity of tissue and allow for the normal regeneration. Tubulization has been attempted with various tissues such as portions of arteries and veins, fascial tubes, fat tubes and the use of gutta-percha, Cargile membrane, and rubber. But the percentage of failures has been so high that these methods have been given up.

Nerve grafts, fresh and fixed, have been used, both homogenous and autogenous, and the successful autogenous grafts used in the repair of the facial nerve have encouraged a new interest in this type of graft. In using nerve grafts to repair the gaps in the larger nerves a graft comprising multiple grafts made from a smaller nerve has been utilized as well as a graft of the same caliber. But of all methods the end-to-end approximation of normal nerve tissue allows

for the normal regeneration for the nerve, and at the present offers the most efficient way of repairing the continuity of the nerve. Wide dissection of the nerve, with flexion of the various neighboring joints, allows for a great deal of nerve stretch. The recent reports from some of the countries which have been at war for some time emphasize that where the gap in the nerve can be bridged by acquiring an extension of both the distal and proximal portions of the nerve through dissection and flexion and an anastomosis can be accomplished without tension, hemorrhage and infection, the chances of a good functional result are a great deal better. Where this is not possible the insertion of a suture through both ends of the nerve and fixing of the ends as closely together as possible with flexion of the nearby joints as a first procedure, the gradual extension of the joints over a period of weeks and a secondary operation attempted in which the ends are approximated has been tried with success. Too much tension on the nerve over a short period of time, however, may interfere with the blood supply or may so fragment the nerve structures that the purpose of the procedure may be defeated.

SUTURE MATERIAL

The use of nonabsorbable suture material has been accepted as the most satisfactory. Catgut sutures produce a marked reaction and may not hold the nerve ends in stable approximation. Silk, and more recently cotton, have been of universal use. Tantalum and steel wire have been used with great success and the fact that tantalum of all the metals produces the least tissue reaction and can be made in very fine strands, may make it the suture material of choice.

The treatment of the suture line after the approximation of the nerve ends has received a great deal of attention. There has always been some question of the reaction of the surrounding tissues playing a part in scar formation and thus interfering with complete regeneration. For that reason fat pads, fascia transplants, Cargile membrane and various materials have been used for wrapping the junction of the nerve in an effort to prevent constriction and suppression of regeneration. Fat produces more scar tissue, as does fascia lata. Cargile membrane either fresh (which is absorbed in 10 days) or fixed (which lasts much longer), sets up very little reaction and can be used with safety. Recently some work has been done with tantalum using a very thin foil and wrapping it about the suture line. Just how much improvement upon the use of no wrappings or the other material remains to be seen, but the inertness of tantalum offers distinct advantages.

The use of a fibrin suture has attracted a great deal of attention as a method of approximating the cut ends of nerves. Young and Medawar carried out experiments in which they used the gel formed

by ordinary plasma in which was dissolved sufficient fibrinogen to increase its normal concentration up to 10 times. The fibrin is applied to the cut ends and allowed to clot with the ends in apposition and thus a continuity of the nerve is provided. Microscopic sections of the suture line show much less reaction than artificial sutures and from the standpoint of reaction it offers a great deal of promise. However those who have attempted the use of fibrin and other mucilaginous substances (gum acacia, etc.) have found that the substances have an insufficient power of adhesion and that too large a proportion of the nerves come apart due to the action of the muscles of the extremities, even though a plaster cast is applied for fixation. At the present time the fibrin suture offers possibilities but as yet is not practical in the repair of nerves.

TIME OF SUTURE

The conception of Wallerian degeneration indicates that the earlier the divided nerve is sutured the better the chances of a good functional result, and there is convincing clinical and experimental evidence to substantiate this view. However, some recent researches would indicate that delayed suture might offer better physiological opportunities for nerve regeneration. Tissue culture of regenerating nerve shows that the proliferating of Schwann's cells and fibroblasts begins after 4 days following division of the nerve. The proliferation rises to a peak between the nineteenth and the twenty-fifth days and then falls to a level at 60 days. At the peak there are 40 times the number of cells there were on the fourth day, and at the end of 60 days there are 15 times the number. Even at the expiration of 13 months there are 5 times as many cells as at the fourth day. Further evidence has been shown that the maximum cellular activity of the central or proximal stump occurs from 5 to 10 days after the section of the nerve. This would indicate that delayed suture would offer the better chance of successful regeneration. Insufficient time has elapsed following these observations to provide any clinical evidence to substantiate the experimental date.

Following the suture of a nerve when the type of operation and the operator are unknown and there is no clinical evidence of regeneration, a certain amount of time should elapse before considering a second operation to determine if an end-to-end anastomosis has been made. Every case should be considered individually and periods from 2 to 6 months should be allowed for observation. If there is no evidence of regeneration then the nerve should be explored. No harmful effects will follow and if a satisfactory suture has not been accomplished much time is saved and regeneration can be initiated.

THE USE OF SULFONAMIDES

The danger of anastomosing nerves in an infected wound has led to waiting until all danger of infection is over. Much clinical and experimental evidence has shown that sulfonamides can be used freely and without danger of inhibiting regeneration. War wounds in which there has been definite infection have been treated with sulfanilamide powder after debridement, the nerve sutured and the wound closed without drainage. No breaking down of the wound has occurred and a finished result has been satisfactory.

The significance of this is far reaching. It may allow earlier suture of nerves in potentially and frankly infected wounds without fear of tissue reaction to either the drug or infection.

A thin film of sulfanilamide powder blown into the wound suffices. It is absorbed, but oral administration of sulfadiazine should also be used as a supportive measure.

SUMMARY

War injuries to the peripheral nerves constitute one of the major problems confronting the medical officer. Differing from peacetime injuries in that usually more tissue destruction has occurred as well as a delay in suturing, new methods of treatment are being developed both here and abroad. However, the fundamental principles of nerve degeneration and regeneration remain the same. Special stains and tissue culture as well as the development of fibrin suture may bring about a new technic, but so far the best results are obtained by end-to-end anastomosis without tension, without hemorrhage and without infection. The sulfonamides do not inhibit nerve regeneration but allow for the suture of infected or potentially infected nerves, thus shortening the period which formerly was allowed for the infection to clear.

Silk or cotton sutures are the accepted suture material but steel and tantalum wire are proving of value, being inert and not associated with any reaction on the part of the tissues.

Nerve grafts are as yet not as efficacious as end-to-end suture, which may be achieved by multiple operations with lengthening of the nerve by wide dissection and primary suture of the separated nerve-ends with flexion of the neighboring joints. The subsequent slow extension of the joints with a secondary suture has been done with success. The blood supply of the nerves is important and should not be interfered with.

After successful end-to-end suture of the nerve, massage and passive motion is of value to keep the muscles in a condition which will be receptive to the regenerated nerve endings. It plays no part in the stimulation of regeneration.

Time for the nerve regeneration to take place should be allowed, but when in doubt it is much better to explore the nerves in which there is not a satisfactory functional recovery. At least from 2 to 6 months should be allowed for observation.

As soon after the operation as possible the patient should be encouraged to give active motion and exercise to the affected extremity and in this way stimulate the musculature.



WAR CONFERENCE

The medical, surgical and industrial hygiene experts who are so ably safeguarding the well-being of more than 20 million industrial workers have agreed to pool their knowledge and exchange their experiences regarding the many new and complex problems of today's wartime production. For this purpose their organizations—the American Association of Industrial Physicians and Surgeons, the American Industrial Hygiene Association, and the National Conference of Governmental Hygienists—are combining their annual meetings in a 4-day "War Conference" at Rochester, New York, May 24-27, 1943.

Among the problems to be discussed from a practical standpoint are:

The mass entry of women into industry.

Older-age employees, with their various associated problems: proper placement and employability considerations of the 4-F rejectees.

Rehabilitation and proper employment of those already discharged from the military services because of disabling conditions.

Toxic and other hazards from new substances, new processes, and the use of substitute materials.

Absenteeism, fatigue, nutrition.

Effects of long hours, double shifts, two-job workers, overtime, increased industrial accident rates.

Advances in the treatment of illnesses and injuries.

This joint meeting will be a report on the state of nation, by the men who know, in matters of industrial health. Dr. William A. Sawyer, Medical Director of Eastman Kodak, is General Chairman; Dr. James H. Sterner and Lt. Comdr. J. J. Bloomfield, USNR, are arranging the programs for the industrial hygienists.

Physicians and surgeons, hygienists, engineers, nurses, executives—all who are interested in the problems of industrial health and their solution—are invited to attend as many of the sessions as they can arrange for; no registration fee is required.

MENINGOCOCCIC MENINGITIS IN THE SAN DIEGO AREA DURING 1942

RECENT ADVANCES IN EPIDEMIOLOGY AND TREATMENT

CHESTER D. AWE

Lieutenant Commander (MC) U. S. N. R.

ROBERT W. BABIONE

Lieutenant Commander (MC) U. S. N.

and

JAMES N. DELAMATER

Lieutenant (MC) U. S. N.

During 1942, 50 cases of meningococcic meningitis entered the United States Naval Hospital at San Diego. Of these, 32 came from the United States Marine Corps base and its subsidiary rifle range. Analysis of these cases will bring out a revised concept of the epidemiology, treatment, and prognosis of this formerly much-dreaded disease.

These 50 cases were distributed throughout the period from February 11 to December 31. During the first 30 days there were 7 cases, all from the United States Marine Corps base and rifle range. During the last 2 months of the year, however, only 4 out of 14 cases were from these activities. The incidence appears to be spread fairly evenly by months, with the following occurrence of admissions:

February.....	4	August.....	6
March.....	5	September.....	1
April.....	4	October.....	2
May.....	3	November.....	5
June.....	5	December.....	9
July.....	6		

Only two instances of bunching occurred, six cases in the last 6 days of the year, and five cases, all from the rifle range, during 6 days in August. In these outcroppings, as well as in the lull from August 12 to October 17, during which only two cases occurred, the influence of weather is observed. A sudden change from warm, dry days to cold, damp nights is a daily feature of San Diego's climate throughout most of the year. This rapid chilling of the air produces colds with regularity among newcomers. Colds have been shown to increase the number and speed of transfer of meningococcus carrier states (1). As the weather improved and colds decreased during the summer, a drop in the rate was expected. It did not occur until September and October. During the last 2 months of the year, cold damp nights returned, and with them the expected increase in colds and meningitis. On the other hand, the group of August admissions was

definitely associated with a period of excessive heat and dust. This climatic factor also has been shown to have a bearing on the morbidity of meningitis (2).

It is notable that 32 of the 50 cases occurred in marines at the Marine Corps base and rifle range. Of the remaining 18, 7 were marines with several months of service. Two cases at the end of November, from a scout and sniper school and a raider battalion, had been sleeping on the ground in the open before becoming ill.

The series of 32 cases from the Marine Corps base and rifle range illustrate the influence of rapid hardening and other factors in the life of recruits on the incidence of meningitis. The training or hardening of marine recruits is begun at the base and continued at the range. As both activities are under the same medical supervision, an excellent opportunity was afforded for observation of the men throughout this period. The epidemiological factors of greatest significance were:

1. The daily induction into training of hundreds of young men, many of whom were under 20 years of age. These recruits represented a typical cross-section of the young male population of the country. Coming from many rural and urban areas, they usually arrived in relatively small groups from the various recruiting centers. The introduction of susceptible nonimmune recruits into a community has been recognized by Banks and other British authorities as a potent factor in the continuance of sporadic outbreaks of the disease.

2. Overcrowding was necessitated by hurried expansion in a limited area due to the rapid influx of recruits. As a result of Glover's research at Caterham during World War I (3), the importance of spacing beds more than 3 feet apart has been repeatedly stressed. Many of the beds in barracks at the Marine Corps base were less than 18 inches apart at the beginning of this outbreak.

3. Fatigue, due to the rigorous training schedule, undoubtedly was a factor contributing to the lowering of physical resistance in some cases. The routine in the Marine Corps is decidedly more strenuous than in other branches of the service. Mental strain is also of great importance.

4. Acute upper respiratory tract infections were extremely common. Catarrhal fever was from two to three times more frequent in recruits than in older seasoned marines. Practically all of the cases which developed in the winter and spring months gave a history of catarrhal fever a few days prior to the onset of meningitis. Sudden changes in temperature along with fatigue and overcrowding play an important role in causation of acute upper respiratory tract infections. MacLean (1) described an epidemic of cerebrospinal fever in Cyprus in 1940. He concluded that sudden changes in temperature or humidity were shortly followed by an epidemic of catarrh. Following

the catarrh, cases of meningococcic meningitis occurred. He also observed that colds aided the passage from person to person of the meningococcus with a consequent increase in its virulence. In the San Diego area colds are common among new arrivals and few recruits escape nasopharyngeal infection.

5. Carriers, not cases, provided the source of every infection. Twenty-one carrier surveys were done on 16 platoons of approximately 60 men each at various times during the year. While the percentage varied, the variations occurred mainly in types II, IIa, and IV, types which are not found in epidemics. The percentage of type I carriers was always low. In 4 platoons studied more than once, the rate was found to rise during the period of training. An attempt was made to determine the existence of a critical level before the appearance of cases. As there was usually a gap of 10 to 120 platoons between cases, no conclusions could be drawn, either for or against the concept of a critical level.

6. Inoculations against typhoid, tetanus, and yellow fever may have an effect on immunity. Sampson (4) reported the occurrence of 78 cases of cerebrospinal fever among troops in a camp in Natal after the inoculation of typhoid vaccine that had been concentrated to eight times the usual potency. He felt that while immunizing inoculations caused the production of specific antibodies, they may also lower body resistance to such diseases as cerebrospinal fever, especially when they are associated with fatigue.

7. Intense sunlight, drouth, and dust are factors in the spread of meningitis in tropical areas, particularly in equatorial Africa (2). Cases which developed at the rifle range in early August had been drilling in very hot, dry weather. Respiratory infections were not prevalent at that time.

PROPHYLAXIS

Because of the intensive activity prevailing at the Marine base in February 1942 it was felt that there should be as little disruption of training as possible. Immediately after the detection of a case, the platoon or school to which the patient was attached was confined to barracks. Head and mess privileges were allowed as usual, except that the restricted platoon was sent to mess after the other platoons had eaten. Beds were spaced 6 feet apart and arranged so that the feet of one man were opposite the head of his neighbor. A medical detail inspected each man in the platoon three times daily and the platoon leaders were notified to report untoward symptoms to the detail immediately. They were also instructed to send men with complaints to sick call at any hour of the day or night.

Each man in the platoon was given 195 grains (13 grams) of sulfanilamide within 72 hours after isolation, 90 grains in three doses

the first 24 hours, 60 grains the second day, and 45 grains the third day. The platoon was then allowed one additional day of rest in barracks before resuming regular schedule. Toxic reactions were infrequent and of very minor degree. One man had nausea and vomiting for a period of 24 hours. There was an average of two toxic skin eruptions in each platoon, but these cleared up within 48 hours after sulfanilamide was discontinued. Only one case was severe enough to require hospital treatment; a case of severe headache. Cyanosis was observed almost universally in one platoon which was allowed to continue classroom instruction indoors, but was uncommon in men who lived in tents which were well-ventilated. Sulfanilamide blood levels and blood counts were not obtained.

There were no renal complications. No secondary cases of meningitis occurred in any platoon during 1942. This was very reassuring to the marine base personnel, as well as to the recruits. The prophylactic measures instituted changed their reaction from one of fear of the disease to nonchalance and confidence that every measure was being taken for their protection. The mild toxic symptoms were more than compensated for by the marked uplift in morale.

In the event of an epidemic, it would be logical to initiate the following measures to prevent its spread:

1. Withhold new drafts of men from the epidemic area.
2. Widely space beds and prevent overcrowding (3).
3. Harden men more slowly.
4. Withhold inoculations until the epidemic is controlled (4).
5. Observe all individuals with colds for the manifestation of symptoms of cerebrospinal fever.
6. Treat all carriers with sulfonamides to end the carrier state (5) (6) (7) (8).

CLINICAL SYMPTOMS AND SIGNS

Clinically, the 50 cases have fallen into the accepted pattern of meningococcic meningitis.

Petechiae.—Twenty-six, or 52 percent of the cases, showed petechiae of varying degree. Of these, one had a true gangrenous purpura; 4 had large purpuric areas on the legs and arms; 11 had very numerous pink spots with petechial nonfading centers which were distributed over the trunk and extremities; the remaining 10 had fewer spots of similar type.

Mental impairment.—Thirty-eight patients, or 76 percent, showed evidence of mental impairment; 11, or 22 percent, were comatose; 27, or 54 percent, were stuporous, irrational or soporous; 12, or 24 percent, were mentally clear. In some of these cases the comatose state developed within 3 or 4 hours after onset.

Neurologic signs.—Forty-six, or 92 percent, of the cases, showed one or more of the following signs to some degree: Headache, nuchal

rigidity, positive Kernig and Brudzinski signs. One complained of pain in his neck and back, but he had no rigidity; two complained of headache and malaise only; one arrived in a deep coma in a moribund condition.

Temperature.—The temperature of the cases on admission was between 97.8° and 106° F. It was most commonly between 100° and 103° F. Reflexes were incompletely recorded.

Laboratory findings.—In 46 cases, or 92 percent, gram-negative diplococci were found in the spinal fluid. In 3 of the above-mentioned cases these were found after very intensive search, and in 3 others, gram-negative diplococci were found only after the spinal fluid had been incubated with glucose solution added. Failure to grow the organisms from the spinal fluid was encountered in 10 instances. Organisms were recovered from the blood of 8, or 16 percent, of the cases.

Meningococci were typed in 31 instances. One culture reverted to a rough form and failed to react with typing sera. Of the 31 typed, 17 were group I, 14 were group II.

Complications.—Two cases had mild sixth-nerve weakness with full recovery. One patient developed an atelectatic consolidation of one lobe during his comatose period, but rapidly recovered. In one case, large hemorrhagic areas in the skin became gangrenous and sloughed. This same patient developed a severe uveitis concurrently with his meningitis, but this cleared completely, and his vision was 20/20 at the time of discharge. This same patient had some synovitis and arthritis in his knees and elbows with complete recovery. There have been no cases of eighth-nerve deafness or labyrinthitis which have commonly complicated reported English cases. Complications to this date have been surprisingly few and very mild. All cases, except the last nine which are convalescent, and the man who had gangrenous purpura, uveitis, and arthritis, have been returned to unlimited duty. This last man will be returned to duty soon.

TREATMENT

Success in meningococcic meningitis depends upon two factors. First, the early recognition of the disease. This means thorough examination of every man complaining of cold and headache or backache, and the constant realization that cerebrospinal fever can mimic any acute infectious process. It is far better to do a spinal puncture on a suspicious case than to allow it to progress until clear-cut signs develop. Delay will only lead to a higher incidence of complications and a higher case fatality rate. A spinal puncture may be of use even in the absence of a microscope, as the finding of cloudy or purulent fluid in an epidemic is sufficient indication to start treatment. Gram stains of the spinal fluid or its sediment are

of great value, as is evidenced by the fact that by the method we were able to find meningococci in 94 percent of the cases.

The second important factor in the treatment of cerebrospinal fever is the administration of sulfonamides in large doses in a short period of time (2). Large initial doses are essential. The primary dose here has been either 4 or 6 grams of sodium sulfapyridine intravenously, followed by 2 grams intravenously every 4 hours. This routine is continued for 3 to 5 days. The drug was given orally in doses of 1 gram every 4 hours after the intravenous therapy was stopped in 29 cases. Of the last 31, the oral route was used in 14 instances, following intravenous therapy. The intravenous route is considered to be essential to obtain the maximum therapeutic effect from the drug early.

That this treatment is effective is shown by the fact that the temperature became normal within 24 to 48 hours, and the comatose or irrational cases became mentally clear within the same period.

The total dose of the drug varied. One patient recovered on as little as 9 grams; another required 93 grams. The average total dose per patient has been 37.58 grams.

In the treatment of any febrile disease in which the patient is unable to take fluids orally, parenteral fluids are necessary. This is especially true in meningococcic meningitis where large doses of sulfapyridine are being given. Patients received a minimum of 3 liters of normal saline, or Hartman's solution, usually with 5 percent glucose daily.

Fifteen of the early cases received meningococcus antitoxin or serum or both in addition to sulfapyridine. No noticeable difference in the clinical course was observed as a result of its use (11). The most marked or constant response to serum therapy was the development of severe serum sickness. The last 31 cases in the series have received no antimeningococcic serum or meningococcus antitoxin. All have recovered promptly. Because serum is bulky, expensive, and perishable, it is impractical in the field. As it often prolongs convalescence because of serum sickness, it may even be contraindicated.

In fulminating cases, especially those manifesting the Waterhouse-Friderichsen syndrome, it is essential to give adrenal cortical extract and salt until reorganization of the adrenal takes place (9) (10) (11). As the shock may be very severe, plasma is indicated as well as other supportive measures.

Complications of drug therapy have been few. One patient had continued hyperpyrexia and delirium even after his spinal fluid was clear. This disappeared after cessation of the drug. One patient had edema of the face and eyelids without any urinary signs. This cleared after withdrawal of the drug and he recovered without further therapy. One man developed hematuria after a total dose of 16

grams of sodium sulfapyridine. This cleared and the meningitis was cured after this small dose of the drug.

Of the 50 cases seen here, 2 have died, a crude mortality rate of 4.0 percent. One of these died 20 minutes after arrival at the hospital and received no treatment. He cannot be considered a therapeutic death. The second died exactly 4 hours after admission to the hospital. While this man received 4 grams of sulfapyridine, his condition at the time of hospitalization was so poor that his death, we feel, cannot be considered a therapeutic failure. If this is accepted, the corrected mortality rate becomes zero. Even the uncorrected mortality rate compares favorably with recently reported mortality rates. Our corrected rate deserves serious consideration.

The first death which occurred was a Marine Corps private, age 35. He had had a severe cold and headache for 48 hours prior to hospitalization. He refused to report at sick call and was treated symptomatically by his sergeant. When he became irrational he was brought to the dispensary and sent to the hospital in a moribund state. He died 20 minutes after admission. At autopsy he was found to have marked edema and congestion of the pia-arachnoid with heavy infiltration with polymorphonuclear leukocytes. Smears from the meninges showed both intra- and extra-cellular gram-negative diplococci which, upon culture, proved to be type II meningococcus. The spleen was intensely congested. The heart showed some fragmentation of the myocardial fibers.

The second death occurred in a Marine Corps private, age 21, in June 1942. This man had complained to his corporal of a cold and some muscle stiffness for several days. The morning he became ill he fainted, vomited 10 or 12 times, and, shortly thereafter, complained of severe headache. Upon admission to the hospital he had a temperature of 106° F., pulse of 140, and respiratory rate of 30. His blood pressure was unobtainable. His heart was fibrillating. There were numerous punctate hemorrhages over the trunk and extremities. There was mild nuchal rigidity, and the Kernig and Brudzinski signs were negative. His spinal fluid contained 35 leukocytes per cu. mm., and gram-negative diplococci were demonstrated on smears. The course was rapidly downward, and the patient dropped into deep shock and died 4 hours after admission. Autopsy revealed a normal brain. There were hemorrhages on the pleurae and pericardium. The mitral valves had a few small vegetations. Both adrenal glands were very large and disrupted by extensive hemorrhage. Antemortem blood cultures showed pure growth of meningococci. It was considered that he died of meningococcemia, adrenal hemorrhage, and vegetative endocarditis. Except for the endocarditis, the essential picture was that of the Waterhouse-Friderichsen syndrome.

We feel that earlier diagnosis and treatment would have prevented the first death, and probably the second, judging from our recent experience. More cases of a comparable degree of seriousness will prove or disprove our thesis: That the mortality rate of meningococcic meningitis should be zero or approach it.

SUMMARY

Fifty cases of meningococcic meningitis, admitted to the United States Naval Hospital at San Diego during 1942, are reported. All cases receiving more than one dose of a sulfonamide recovered. Complications were rare and temporary. Two deaths occurred, one 20 minutes, the other 4 hours after admission. These are not properly chargeable to therapeutic failure, as one received no drugs, the other only one dose.

That the cases were not unusually mild is shown by the fact that 11 were comatose and 27 were stuporous, irrational, or otherwise disturbed mentally. These patients showed striking improvement within 24 hours whether on sulfapyridine alone or on serum and sulfapyridine. The temperatures fell promptly and the sensorium cleared rapidly. Fifteen cases received serum and sulfapyridine. The last 31 cases received sulfapyridine alone with no deaths. No difference was noted in the progress of cases treated with serum as compared with those not receiving it, save in the high incidence of troublesome serum sickness.

The therapeutic success achieved in this series depended upon *early and large* doses of sulfapyridine, 12 grams intravenously in the first 24 hours. Adequate fluid intake, 3,000 cc., intravenously daily, prevented serious drug complications.

The two deaths illustrate the importance of early diagnosis. One also illustrates the Waterhouse-Friderichsen syndrome, a not uncommon complication of fulminating meningococcemia.

Epidemiologically, there were no secondary cases. Early anxiety was quieted when troops were placed on a simple prophylaxis, and the results of treatment of actual cases became known.

All factors excepting avitaminosis, which are currently accepted as fostering outbreaks of meningitis, were noted in a series of 32 cases occurring in marine recruits:

1. Rapid hardening of physically soft men.
2. Mobilization of large numbers of susceptible men in crowded quarters.
3. Increased prevalence of colds.
4. Temporary overload of immunological processes.
5. An underlying carrier state out of which only rarely did a clinical case develop.
6. The effect of excessive heat and dust.

An outline of six measures of possible value in checking a larger scale outbreak is given. A schedule of chemoprophylaxis as used at the United States Marine Corps base is outlined.

CONCLUSIONS

1. With early diagnosis and adequate treatment, the mortality and complications of meningococcic meningitis will approach zero.
2. Sulfonamides alone, in large doses, with ample fluid, provide adequate treatment.
3. Serum is unnecessary and impractical for military use.
4. Sporadic cases are to be expected in men subjected to the conditions found in recruit training.
5. Watchfulness, not anxiety, is indicated at the appearance of meningitis in troops.
6. In the event of an epidemic of meningococcic meningitis, chemoprophylaxis is recommended, and alterations in the training program may be necessary.

From December 31, 1942, to March 22, 1943, 51 additional cases of meningococcic meningitis were admitted to the U. S. Naval Hospital, San Diego, Calif. Forty-nine recovered on chemotherapy alone. One patient died without treatment, his condition being obscured by severe diabetic coma; the other received 12 grams of sodium sulfapyridine, but died 26 hours after admission, with myocardial failure.

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CONSTIPATION

One of the disturbances associated with constipation is intestinal putrefaction. The bacteria inhabiting the lower part of the intestines are more or less of the putrefactive type; and when the food mass is permitted to stagnate in the colon, these bacteria may multiply in number to an alarming degree. The action of such organisms upon unabsorbed protein produces toxins which place an extra burden on the liver and endanger the health of the individual.—Proudfit, F. T.: *Diet in Disturbances of the Intestines. Nutrition & Diet Therapy, Eighth Edition: 505-523, 1942. The Macmillan Company, New York, New York.*



BLAST LUNG

The mechanism by which the changes are affected is believed to be mainly the wave of intense compression of the air which constitutes the "blast," and probably less to the subsequent wave of negative pressure which follows immediately upon the compression, provided the latter has the space in which to dissipate itself. The effects of blast appear to be undoubtedly more severe in the enclosed spaces within buildings than in the open. It has been thought that powerful waves of compression and suction might produce their effects via the air passages directly on the interior of the lung; the more generally held opinion is that the intense damage to the lung is due to direct and abrupt compression of the chest. The similarity of the pathological changes seen in the lungs of patients killed by blast in the enclosed spaces of buildings to those found in cases killed while immersed in the sea by the effects of the concussion from bursting depth charges is strongly in favor of the second hypothesis.—Davies, H. M., and Coope, R.: *Pathology. War Injuries of the Chest. 22-32, 1942. The Williams and Wilkins Company, Baltimore, Maryland.*

THE TREATMENT OF ACUTE PROCTOLOGICAL CONDITIONS AFLOAT ¹

EMIL GRANET

Lieutenant Commander (MC) U. S. N. R.

Inordinate pain, out of all proportion to the extent of the lesion, characterizes acute anorectal and perianal disease. Consequently the service patient so afflicted either cannot stand his watch, or does so of necessity with impaired efficiency. These conditions are unusually prevalent among naval personnel at sea. In the first 6 months of 1941 at the United States Naval Hospital, New York, 20 percent of all surgical operations performed, exclusive of those on the ear, nose, and throat service, were for the relief of proctological lesions. Similarly during the first half of this, a war year, at a Caribbean naval station, anorectal disease accounted for 26 percent of operations performed on naval personnel, most of whom were seagoing.

Arduous living and working conditions afloat during war undoubtedly aggravate factors instrumental in the causation of acute anorectal disease. The immediate treatment of these, even thought palliative, will help accomplish the chief mission of the naval medical officer—to keep our men at their work. Proctological emergencies commonly occurring at sea to be considered in this paper comprise:

1. Hemorrhoids:
 - (a) Acute, thrombotic external.
 - (b) Prolapsed, strangulated internal.
2. Fissure in ano.
3. Abscess:
 - (a) Perianal.
 - (b) Periprocttic.
 - (c) Pilonidal cyst, infected.
4. Coccygodynia.
5. Impacted feces.

In general, dyschezia (difficult or painful defecation) is the important causative factor responsible for conditions in groups 1, 2, 3a, 3b, and 5. Arduous and irregular living and eating conditions aboard ship; the inability while on watch to leave one's post to heed the call of nature leads to oft repeated accumulations in the rectum of heavy, bulky, and inspissated fecal masses. Constantly repeated, this sequence results eventually in the loss of the defecation reflex, "nature's call," so that soon a distended rectum is tolerated with little or no discomfort.

The weight of the bulky mass resting on the veins of the hemorrhoidal plexus causes stasis and engorgement, so that in many indi-

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viduals endowed with weak vein walls, this situation terminates at long last in the formation of rectal varicosities, hemorrhoids. Furthermore, during defecation, trauma incident to excessive straining and overstretching of the anal canal in the attempt to pass the oversized fecal mass may further injure the intima of the varicosities to result in inflamed thrombotic hemorrhoids. Overstretching may tear the anal mucoderm and so give rise to anal fissure. When an anal crypt is similarly traumatized, a local abscess may ensue which breaks through laterally to become manifested as a troublesome periproctical abscess. Fecal impaction is not uncommon among naval personnel and its mechanism is obvious.

Falls on deck or down ladders, bumps against bulkheads or ship's gear result frequently in injury to the coccyx which is soon manifested as a painful, disabling coccygodynia. Likewise, blows in the sacral region may be the activating cause of inflammation and subsequent abscess in a hitherto quiescent pilonidal cyst.

In the conditions under discussion several advantages accrue from early treatment:

1. Little or no working time is lost by the patient.
2. Transfer to and from a naval hospital on arriving in port with its complex paper work, movement of patient's effects and the disruption of trained crew units may be avoided.
3. Early operation relieves the patient of prolonged and excessive pain and the impairment of efficiency that is caused by these.
4. In perianal abscess, early drainage will minimize the extent of the lesion and its resultant fistula so that elective secondary operation for the latter can be performed ashore while the ship is in the yard for overhaul or repairs.

ANESTHESIA

Local field block is sufficient when dealing with thrombosed external hemorrhoids. For more extensive rectal surgery, caudal epidural block is ideal in that perfect anesthesia and sphincter relaxation is attained with none of the dangers and meticulous aftercare necessitated when spinal block is utilized. The technic is simple and readily acquired (1). With the patient prone on the table, the hips resting on a folded pillow in the inverted jackknife position, 60 cc. of 1 percent procaine solution is injected into the caudal canal through the sacral hiatus, using a spinal-tap needle. The sacral hiatus is palpated as a depression about 6 cm. from the tip of the coccyx, surmounted proximally by two small bony tubercles about 1 cm. apart. Following skin anesthesia the needle is inserted perpendicularly to the skin to impinge on the bone of the sacrum. With the index finger of the left hand depressing the needle point in the tissues, direction is changed and the needle is thrust approximately parallel to the plane of the sacrum to enter the caudal canal. About 4 cm. should be inserted. To make sure that the dura has not been penetrated, aspira-

tion of spinal fluid is attempted. When this is not forthcoming, procaine is injected, slowly at first to guard against the occasional procaine sensitive individual, then fairly rapidly. Transient pain in the lower back and down the sciatic nerves during the injection portends excellent anesthesia in about 15 minutes. The occasional failure of anesthesia, 3 percent in my last series, is attributable to anatomical deformities which prevent deposition or retention of the drug in the caudal epidural space. If this should occur, infiltration anesthesia to include the sphincter muscle is administered.

Anesthesia for the drainage of abscess of a pilonidal cyst requires little more than freezing the point of incision with ethyl chloride. If more extensive procedures are contemplated, intravenous sodium pentothal is ideal.

TREATMENT

Conservative medical treatment in the conditions under discussion avail little and is sometimes dangerous inasmuch as these lesions tend to progress. Preoperatively it is advisable to empty the rectum by a simple enema, and in hirsute individuals local shaving as indicated. Adequate exposure is attained with the patient in the inverted jack-knife position, adhesive bands attached to the buttocks and sides of the table so as to exert moderate tension, thus spreading the former apart. A soap and water scrub followed by swabbing with tincture of merthiolate completes the preparation.

HEMORRHOIDS

Acute external thrombosed hemorrhoids or perianal hematomata are very common. They are seen as painful, bean-like, bluish nodules which progressively increase in size and tenderness. They may be multiple. The pain is due to tension, edema and inflammation acting on the rich sensory network about the anus. Removal of the hematoma affords immediate relief of pain. This procedure is simple and should not be delayed.

Field block with procaine is instituted. The epidermis over the most prominent part of the tumor is grasped in an Allis clamp, the bite applied superficially and radially to the anus. The skin in the bite of the clamp is excised with scissors, a radially placed elliptical incision resulting. The dilated, thrombosed vein is exposed in the wound. The skin edge on one side is picked up in the clamp and with careful, blunt-scissor dissection the thrombosed vein is separated from the surrounding tissues. The opposite side is similarly treated. The vein and its thrombus should now lie free with its pedicle at the anal margin. The pedicle is ligated proximally with fine plain catgut and the lesion excised. Redundant skin is trimmed flat to prevent tab formation; a thin strip of iodoform gauze is laid in the wound and a

gauze dressing is held over all with adhesive. The patient can return to work immediately. After 24 hours the gauze is removed and hot sitz baths are instituted. Epithelialization is complete in 10 days.

Thrombosis of internal hemorrhoids with extrusion or prolapse of the pile mass below the sphincter results from the trauma of the forced passage of a bulky, inspissated stool or occasionally from a severe diarrhea. The term strangulation in most cases is a misnomer, as the sphincter muscle in such cases is usually found relaxed. Because of sphincter relaxation it is difficult to maintain the prolapsed pile mass in the rectum after reduction.

The best contemporary opinion as to the vexing question of treatment for this distressing condition favors immediate operation. A questionnaire on conservative versus immediate operative treatment directed to 116 members of the American Proctologic Society resulted in the data that 76 operate promptly upon acute strangulated hemorrhoids whereas 38 do not, the latter favoring expectant local treatment to allow subsidence of the acute inflammatory process (2).

It is disconcerting and alarming to be confronted with a patient having a ring of huge, thrombosed, and sloughing hemorrhoids protruding from the anus. Extensive proctologic surgical experience is required to deal adequately with just such a case, inasmuch as sacrifice of too much mucosa and skin at operation will result in a troublesome, invaliding anal stenosis. On large ships with adequate surgical operating facilities, a simple ligature type of operation should restore the patient to duty in about 10 days (3).

In most cases aboard ship immediate operation is not feasible. Therefore the patient is put to bed, placed in the Sims' position with a large, hot, wet pack, usually of boric acid solution, this held in place against the anus by a T-binder. A hot water bag placed against the perineal dressings and supported by cushions helps to maintain heat. The hips are raised on firm cushions to favor dependent drainage of the hemorrhoidal veins and lymphatics. A soft diet, paregoric to control tenesmus if indicated, and absolute bed rest are essential. The rectum should be emptied every other day by a warm soapsuds enema, thereby avoiding the added trauma of evacuating a hard fecal mass. Resolution of the pathological lesion is slow, 10 days to 3 weeks, within which time transfer to a naval hospital for an elective hemorrhoidectomy can usually be accomplished.

FISSURE IN ANO

For such an insignificant lesion, acute anal fissure causes pain which is prodigiously overwhelming in its intensity. Characteristically, for days patients desist from defecation for fear of the tearing, burning pain associated with and following this function. The tearing open

of the inflamed, sensitive fissure during passage of the fecal mass and retention in the wound of chemically irritating fecal matter are productive of the inordinate pain. Interestingly enough, persistence and progression of the lesion is aggravated through nature's attempt to splint the wound by reflex spasm of the anal sphincter muscles. This spasm is vigorous and continuous. It produces ischemia in the wound and edema of the adjacent skin. The edema is manifested as the characteristic "sentinel pile" associated with persistent fissure. Failure of the acute fissure to heal may be attributed primarily to ischemia of the tissues in and about the wound.

Treatment in the early acute stage consists simply of relieving the spasm of the sphincter muscles thereby restoring normal circulatory balance. This is readily accomplished by overdilating the anal sphincter muscles under caudal anesthesia. Such deliberate trauma to muscle fibers and nerves results in a transient paralysis and subsequent hypotonicity of the sphincteric action which persists for several days. In this time adequate circulatory balance is restored in and about the fissure so that healing by granulation occurs. Hot sitz baths and hot rectal lavages stimulate healing. The treatment of fissure by applications of silver nitrate so commonly used is bad practice as it is productive of severe pain and spasm and serves no useful function in the acute stage.

A popular contemporary treatment of this painful lesion consists of the local injection of anesthetic agents dissolved in oil. Among these are proprietary preparations such as anucaine, eucupine in oil, butyn in oil, and numerous others obtainable in the market through open purchase. The anesthetic oil is injected under and on each side of the fissure into the sphincter muscle. Relaxation of muscle spasm is attained both by direct anesthetic effect on the muscle as well as by the elimination of pain and its resultant reflex spasm. As the active chemical is released slowly to the tissues from its oily solvent, anesthetic effect is prolonged for about a week. These drugs are tissue irritants and occasionally if pooling in the tissues occurs due to faulty injection technic, suppuration results (4).

For chronic fissure, radical excision is the only curative treatment because the edema, fibrosis, and infection associated with this type of lesion prevents adequate healing.

ABSCESS

Perianal.—The crypts of Morgagni and the associated anal ducts at the anorectal margin are obviously fertile and primary sources of perianal infection. This was recently demonstrated by Tucker and Hellwig (5). Infection and subsequent swelling of the anal papilla at the entrance of the duct seals in the infection and prevents drain-

age. Suppuration within the duct ensues with later extension of this into the perianal space. The abscess is now manifested as a brawny, tender, inflamed nodular mass readily palpable between the thumb and the cotted index finger, the latter palpating through the rectum. Symptoms consist of throbbing pain, anal tenesmus, and painful defecation. Surgical treatment at this early stage is indicated to prevent wide extension of the infection and resulting complex fistulae.

Caudal block or intravenous pentothal anesthesia is instituted, as local procaine infiltration is interdicted by the presence of suppuration. Following adequate anesthesia, the gloved index and middle fingers of the left hand are passed into the rectum and hooked around the sphincter. With these fingers supporting the abscess, an exploratory stab wound is made into the abscess at its most prominent point. Drainage is facilitated by making this wound parallel to the direction of the fibers of the sphincter muscle, because contraction of the latter favors gaping of the wound borders. After foul smelling pus is evacuated, the wound is enlarged to admit an exploring finger. Pocketing in the cavity is broken down and with scissors the wound is enlarged to the margins of the cavity. Iodoform packing completes the operation. This is removed in 48 hours. Further packing is not advisable as this tends to form fibrous granulation tissue which delays healing.

Periproctie.—The original duct abscess may extend through the external sphincter muscle to enter the ischiorectal space. Due to loose tissue structures, fat and relatively few sensory nerves, the abscess must attain considerable size before symptoms are manifested. The patient gradually becomes aware of a brawny, inflamed, tender swelling medial to the buttock. Temperature and other systemic symptoms are common. Earliest possible drainage is indicated in order to prevent extension upward into the superior rectal space and thereby possible peritoneal involvement.

Treatment is similar to that of perianal abscess, consisting of exploratory stab and finger exploration. In this type of abscess however, the cavity must be completely and widely unroofed so that a large saucer-shaped wound remains. Only by saucerization to insure adequate drainage can complete healing from the bottom of the abscess occur. Fistulae remaining after such abscesses are frequently attributable to poor drainage due to inadequate unroofing on the part of a timid surgeon. Fistulae which remain after the abscess heals can be dealt with electively when convenient.

Pilonidal cyst.—Following direct trauma over the sacrum, a hitherto quiescent and symptomless pilonidal cyst can suppurate, as indicated by tenderness, redness, and a progressively increasing swelling. Simple incision and drainage performed early will relieve pain and minimize the extent of the lesion. Local freezing at the point of

incision affords sufficient anesthesia. Following drainage, swelling and induration subside rapidly and the patient can continue on duty with only a small draining sinus until such a time when excision of the cyst is convenient.

COCCYGODYNIA

Falls in the sitting position with direct trauma to the coccyx are frequent aboard ship. The disturbing syndrome known as coccygodynia often results. In the absence of fracture or dislocation of the coccyx, these occurring infrequently, the actual cause of pain is due to severe spasm of the pelvic muscles attached to the lateral aspects of the coccyx. These are the levator ani, the coccygeus, and the pyri-formis muscles.

Simpson, in 1859, wrote that tonic spasm of these muscles follows injury to the coccyx or its articulations. Characteristic symptoms include pain referred to the rectum, the buttocks, or down the back of the thighs. The inability to remain seated for any length of time is usual. Symptoms persist despite local heat, analgesics, and even coccygectomy. Digital rectal examination reveals the coccyx itself to be not unduly tender. However when the examining finger is swept laterally, the levator ani and coccygeus muscles are found to be spastic and exquisitely tender. In cases of fairly long duration I found a number with well-developed, tender, and crepitant bursae palpable between the levator ani and coccygeus muscles at about their midportions. This coccygeal bursitis probably accounted for the persistence of symptoms.

Thiele (6) recently described a highly successful yet simple method of treatment for this disabling condition. By means of a cotted finger fully inserted in the rectum, the patient in the Sims' position, gentle, stroking massage of the spastic muscles in the direction of the fibers is instituted. Treatments are of 1 to 2 minutes duration on each side and are repeated daily at first, then every second day until about 12 treatments have been administered. Cure or marked improvement results from this simple measure in about 80 percent of the cases.

FECAL IMPACTION

In patients who are habitually constipated, this complication is the obvious result. Such cases are seen not uncommonly aboard ship. Purgation or enemas are futile when impaction is of long duration even though some intestinal contents may bypass the fecal mass in the rectum. Mechanical disruption of the hard, inspissated fecal tumor by means of the operator's gloved finger is the obvious though disagreeable treatment. After partition and partial removal of the obstruction, a soapsuds enema followed by a warm rectal lavage will

completely empty the rectum. As a preventive measure against recurrences the patient must be instructed in proper bowel habits.

SUMMARY

1. Acute proctological lesions commonly occurring in naval personnel at sea which should be treated promptly include external, thrombotic hemorrhoids (perianal hematoma); prolapsed, strangulated, internal hemorrhoids; fissure in ano; perianal and periproctie abscess, abscess of a pilonidal cyst; coccygodynia; and fecal impaction.

2. Medical treatment of these conditions accomplishes little and is often deleterious in that the primary lesion may spread and so become complicated. A possible exception to this exists in the case of prolapsed, strangulated internal hemorrhoids.

3. Ideal anesthesia for proctological surgery is afforded by caudal epidural block. Field block by infiltration and intravenous anesthesia have their indications.

4. Treatment of the conditions under discussion is briefly outlined.

5. Advantages of early treatment aboard ship include:

(a) Little or no working time is lost by the patient.

(b) Prompt relief of pain and disability results.

(c) Transfer of patients and their effects and records to and from hospitals ashore with its annoyances and disruption of trained crew units may be avoided. After palliative surgical treatment, completion of cure may be delayed as an elective procedure to be performed when the ship is in the yard for overhaul or repairs.

6. Early treatment of these proctological emergencies enables the medical officer afloat to fulfill his chief function—to keep our men at their work.

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TOOTHACHE AND THE AVIATOR

A STUDY OF TOOTH PAIN PROVOKED BY SIMULATED HIGH ALTITUDE RUNS IN A LOW PRESSURE CHAMBER

THADDEUS V. JOSEPH

Commander (DC) U. S. N. R.

CHARLES F. GELL

Lieutenant Commander (MC) U. S. N.

ROBERT M. CARR

Lieutenant (MC) U. S. N. R.

and

MOSES C. SHELESNYAK

Lieutenant (junior grade) H-V (S) U. S. N. R.

During the course of routine indoctrination and classification runs in the low pressure chamber at the Naval Air Station, San Diego, Calif., conducted over a period of 6 months, observations made on individual reactions to altitude changes revealed an incidence of toothache in 1.2 percent of cases. The onset of tooth pains had no particular relationship to specific altitude, beyond the fact that the greatest number of pain reactions occurred at the highest altitude reached. Fifty-seven percent of cases experienced pain at 28,000 feet, 23 percent at 18,000 feet, and the remaining 20 percent at 10,000 feet or below. About half of the men reported their toothache as a sharp pain, while the other half complained of a dull ache.

Whenever a toothache was reported or discovered by questioning of individuals who complained of pain in the region of the upper or lower jaw during a simulated altitude run in the chamber, the man experiencing the pain was sent to the Dental Department where his teeth were thoroughly checked. These examinations revealed that dental conditions which give rise to symptomatic pain during low pressure chamber runs may be divided into two categories:

1. Pain caused by the reaction of vital pulps of carious teeth to the change in atmospheric pressure.
2. Pain caused by the reaction of degenerated gangrenous pulps to the change of atmospheric pressure.

A third condition may occur, namely, the existence of a faulty inlay with a small underlying residual air space. Upon exposure to lowered atmospheric pressure, the air in this space will expand, causing pressure stimulation of nerve endings with resultant pain and occasionally expelling the inlay. This report embodies typical histories of cases falling within the first two categories. No cases of the third type were found in the present series.

Of the first classification, which included numerous cases, the following two histories are presented in detail as typical examples:

Case A was a member of a dive bombing squadron. This pilot reported that it was a common experience for him to have a marked pain at altitudes just previous to going into his dives. Although the severity of this pain increased with time, the pilot attributed the pain to a possible mild sinus infection. The pain became so regular on flights, that it became a disturbing factor. In the course of a simulated flight in the low pressure chamber, the pain occurred with its usual persistent regularity. At the suggestion of the flight surgeon in charge of the chamber, the pilot reported to the dental clinic for examination. Four carious teeth were properly restored without remedial effects. Next an old restoration on the lower right second molar was removed and secondary caries excavated from a lateral wall which was not apparent in the radiograph. A protective cement base was placed followed by a suitable amalgam restoration. This eliminated all the annoying symptoms which had formerly occurred.

Case B was a pharmacist's mate first class assigned for duty in the low pressure chamber. Numerous rather severe pain symptoms were experienced by this man before he revealed his discomfort. Radiographic examination disclosed a deep proximal cavity on the distal surface of the upper first molar. Procaine was used because of extreme sensitivity and all carious tooth substance was removed without pulp exposure. A cement base was placed after which a suitable restoration was accomplished. There was no recurrence of the previously experienced pain and the man was able to carry on his duties within the low pressure chamber.

The following two cases may be given as typical of the second classification:

Case C started the usual altitude run in the low pressure chamber and at 5,000 feet simulated altitude he experienced a marked pain. At an atmospheric pressure equal to 9,000 feet he no longer could stand his discomfort. He was returned to sea level pressure. This man did not get relief by descending to sea level. Dental examination including a radiographic study revealed a deep-seated cavity in the upper left first bicuspid which had been filled with a sedative filling. Procaine injection relieved the pain in this area and the tooth was removed. Examination of the extracted tooth disclosed a gangrenous pulp.

Case D experienced the first pain at a simulated altitude of 10,000 feet. He was able to make the full run in the chamber, but volunteered the information of a continuous throbbing pain in the upper left first molar region. Radiographic examination revealed a deep disto-occlusal cavity which had previously been treated with a sedative type of filling. Subsequent treatment disclosed the painful symptoms were induced by a degenerated pulp beneath a temporary sedative filling.

SUMMARY AND CONCLUSIONS

1. Toothache was provoked in 1.2 percent of men exposed to simulated altitude runs in the low-pressure chamber.
2. The nature of the histologic structures of the teeth allow little compensation for circulatory or gaseous volume changes within the confined area of the pulp chamber, root canal or apical alveolar structure.
3. After thorough dental examination, it was determined that these toothaches provoked by lowered atmospheric pressures were caused by one of two conditions: (a) The reaction of vital pulps of carious

teeth to lowered atmospheric pressure, and (b) the reaction of degenerated gangrenous pulps to lowered atmospheric pressure.

4. A third condition may occur, namely, the existence of a faulty inlay with a residual air space beneath. Expansion of this air upon exposure to lowered atmospheric pressures may cause painful stimulation to nerve endings or expulsion of the inlay.

5. Great care should be exercised in determining the pulp conditions present in teeth previous to any restorative procedure especially for those who may be subjected to rapid atmospheric pressure changes.

6. Pain symptoms of dental origin as revealed in the low pressure chamber may at times assist in disclosing hidden degenerative or carious processes affecting the normal functioning of an individual under certain conditions of varying altitudes.

7. Aviators suffering pain in the region of the maxilla when flying at high altitudes may not realize the dental origin of their discomfort and attribute it to a maxillary sinusitis.

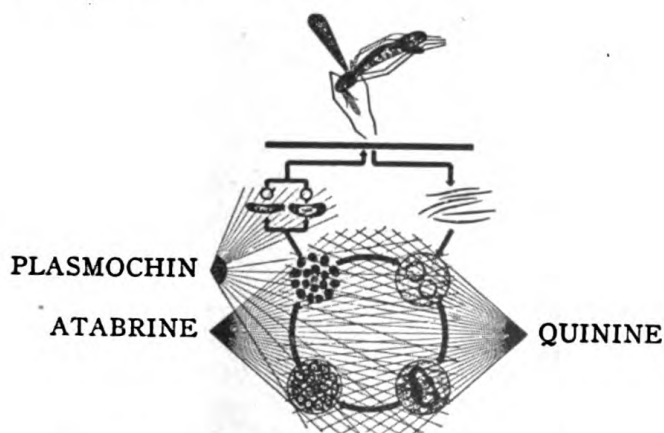


MODERN ANTIMALARIALS

A timely article in the December issue of the American Journal of Pharmacy on "Modern Antimalarials" by Maximilian Ehrenstein, Assistant Professor of Chemistry Assigned to Medicine, School of Medicine, University of Pennsylvania, discusses each of the better-known antimalarials chemically and pharmacologically.

The following diagram illustrates the effectiveness of each substance and its action upon the plasmodium cycle.

From the diagram it is seen that—



Plasmochin.—Plasmochin possesses a selective and very powerful action on the gametocytes of all species of Plasmodium, hence it will make any case of human malaria noninfectious for mosquitoes. It interrupts the man-mosquito-man vicious cycle. The systematic

administration of plasmochin to carriers of any type of malaria should aid greatly in the eradication of the disease. It has a chemotherapeutic index of 30.

Since the margin of safety is narrow the drug should be administered only under a physician's supervision.

Because of its toxicity it cannot be given in large enough doses to eliminate the schizonts and gametocytes, but relatively small doses will destroy the gametocytes. Given in conjunction with quinine, the schizonts and gametocytes will be destroyed simultaneously and the rate of relapse will be lessened greatly.

Atabrine.—Atabrine exercises a definite action upon the schizonts of all known species of malaria. It has little or no comparable action upon the gametocytes. Its chemotherapeutic index is 30. It does not prevent infection but only will retard the development of the parasites, and, therefore, is not a direct chemoprophylactic agent.

Its toxicity is low and its margin of safety is wide. Slowly eliminated, the drug has a considerable cumulative effect. Atabrine has been found in the urine 9 weeks after the termination of treatment. Consequently the second phase of the treatment should not be instituted under 8 weeks.

Atabrine and plasmochin should not be given together because of their toxic effects. Plasmochin, however, given after the conclusion of atabrine therapy produces a marked decrease in relapses of all three forms of malaria.

Quinine.—Quinine destroys in the peripheral blood stream the asexual forms and the gametocytes of *Plasmodium vivax* and *Plasmodium malariae*, while in the case of *Plasmodium falciparum* the asexual parasites only are eliminated; the gametocytes remain unimpaired. Quinine has a chemotherapeutic index of 4. It is not a true chemoprophylactic. However, the growth of asexual parasites will be retarded greatly but not eliminated. They slowly multiply and when the drug is removed the paroxysmal attacks reappear.

The toxicity of the drug is low and the drug itself is quickly eliminated. Idiosyncrasy to quinine is a frequent occurrence.



SECONDARY MANIFESTATIONS OF DERMATOPHYTOSIS

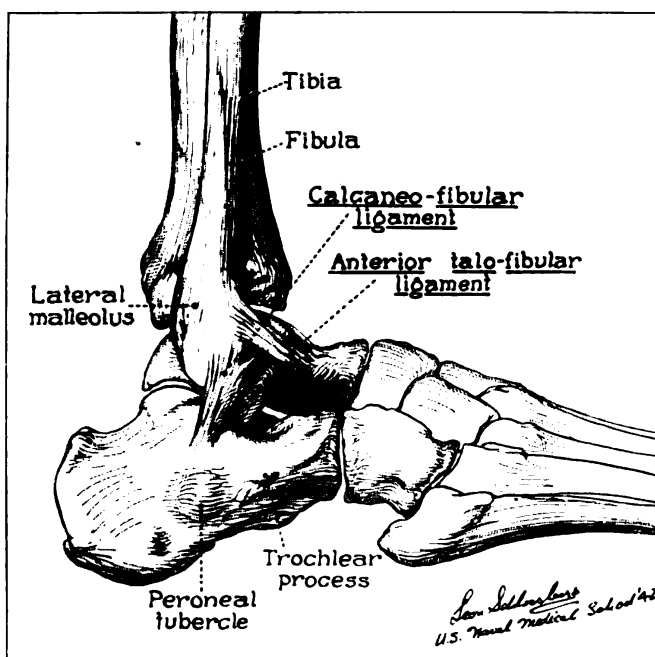
The secondary manifestations of dermatophytosis, whether they are vesicular, eczematoid, or some other clinical form, cannot be properly treated unless the primary infection is eradicated. The prevention of their recurrence is also a problem of eradicating the focus. Difficulty in treatment is caused by the fact that often there exists such a degree of hypersensitivity to the fungi or their products that only a small focus between the toes or under a toenail may result in marked generalized manifestations, i. e., dermatophytids.—Peck, S. M., and Schwartz, L.: A practical plan for the treatment of superficial fungus infections. Pub. Health Rep. 58: 337-345, February 26, 1943.

AVULSION FRACTURE OF THE FIBULA¹

MORRIS I. BIERMAN

Lieutenant Commander (MC) U. S. N. R.

A review of a number of texts on the subject of ankle injuries discloses a marked difference of opinion as to their treatment and the length of time necessary for such treatment. In "simple" sprain, immobilization from a few days to about six or eight weeks, depending entirely upon the opinion or experience of the writer as to the degree of severity of the injury, is generally recommended. There are also advocates of immediate walking with an injured ankle following local anesthesia, "freezing," or immobilization.



1. DIAGRAMMATIC REPRESENTATION OF ANKLE SHOWING ANTERIOR AND MIDDLE FASCICULI OF FIBULAR COLLATERAL LIGAMENT.

There does not appear to be a satisfactory differentiation between sprain and "chip-fracture." Occasionally a fracture of the fibula (chip-fracture) is present without its presence being suspected. This is possible because often a routine of x-ray examination is followed which does not show all types of fracture. A review of the pathological anatomy of the ankle will disclose why this is so.

On the lateral aspect of the ankle, a triangular (fibular collateral) ligament unites the fibula to the os calcis and talus. This ligament consists of three distinct bands or fasciculi. The anterior fasciculus

¹ Received for publication November 21, 1942.

runs from the anterior border of the lateral malleolus anteriorly and medially to the body of the talus in front of its lateral malleolar surface. The posterior fasciculus extends horizontally from the depression on the medial side of the malleolus to the lateral tubercle of the talus. The medial fasciculus is the one most often involved in injuries. It runs from the lower part of the anterior border of the malleolus distally and slightly posteriorly to the tubercle on the lateral surface of the os calcis. This fasciculus is generally known as the fibulocalcaneal ligament.

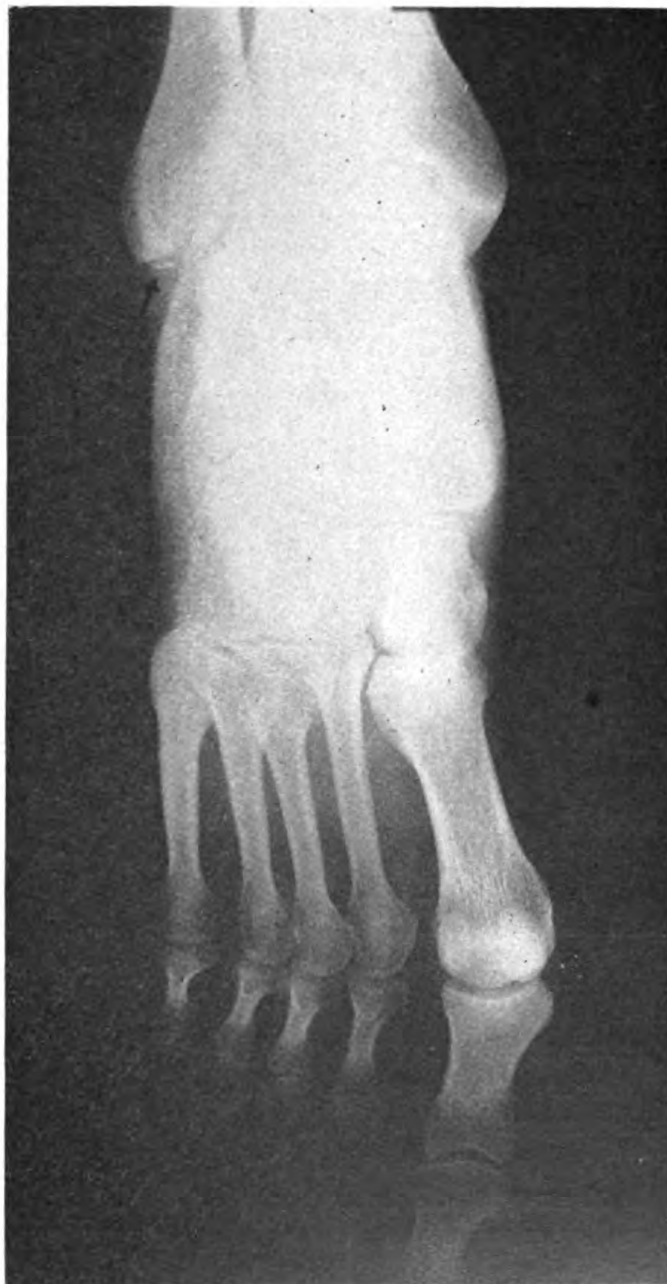
The anterior and middle fasciculi are the ones generally involved in sprain. This is because a sprain is generally an inversion injury, or inversion and inward rotation. These two mechanisms put an undue strain on the anterior and middle ligamentous bands.

There can be recognized two degrees of injury to the ankle joint. First, there is the simple sprain. In this injury there is tearing or stripping of a few fibers of the middle or anterior ligamentous bands. As a consequence blood is extravasated into the surrounding tissues, there is more or less effusion into the joint, and the soft tissues on the lateral aspect of the joint are stretched. In quite mild cases the patient may be able to walk without a great deal of pain. On palpation of the site of swelling there is generally found localized tenderness on the outer side of the joint, in front and below the external malleolus. The pain is markedly increased when the foot is inverted. Quite characteristically of sprains, the pain persists even when the foot and ankle are at rest.

If the injury is severe, the pain is especially acute and spreads to the foot and leg. Because of the severe pain, inability to maintain weight bearing, to a greater or lesser degree, results. It has been noted that in a severe sprain the pain is usually more intense than with simple fracture.

In the above-described injury, there is no bone involvement. In mild cases, the foot and ankle are put to rest for a few days and healing is rapid and complete. The stability of the joint is unimpaired. In the more severe injury, where more of the ligamentous fibers are torn, the foot is elevated for a few days until the swelling subsides, and then strapping is applied. The adhesive strapping begins on the inner border of the foot, runs across the sole, and then up over the outer side of the ankle to the leg. The ankle should be slightly everted so that the strain on the external ligament is relieved. After the more acute symptoms have subsided, weight bearing is permitted. Weight bearing and use are allowed only when the pain is not marked and then only within the limits of the pain. Should swelling and edema persist, an elastic anklet should be worn until the tissues appear normal and the pain is relieved.

The second type of ankle sprain is a more severe injury. It is probably to this class that the chip type of fracture, which is the subject of this paper, belongs. Instead of there being only the tearing or stripping of a few ligamentous fibers, there is complete or nearly complete tearing of the middle, anterior, or both ligamentous bands, or a portion of the fibers of each. With a tearing strain of the middle band, a thin, elliptical fragment of bone is avulsed from the anterior margin of the fibula, distal end. When this small fragment of bone is avulsed from the fibula, it is conclusive evidence that the injury is equivalent to a complete rupture or tearing of the ligamentous band. In the avulsion of this small fragment of bone the ligament would necessarily have been completely stretched, with the result that instead of rupturing within itself, the complete giving way was at the insertion, bringing a fragment of bone with it.



2. ARROW INDICATES FRACTURE OF FIBULA WHICH CAN OTHERWISE NOT BE DEMONSTRATED.

It can be assumed that with this injury, there is a momentary subluxation of the ankle joint. This momentary subluxation is spontaneously reduced, so that when an x-ray is made, the joint appears normal. Instability may result, and the inversion injury tends to

recur unless the condition is treated as one of fracture. This subluxation injury may be demonstrated by x-raying the ankle while maintaining strong eversion. The mortise will be found widened on its lateral side.

The usual x-ray technic will not demonstrate an avulsion of the fibulocalcaneal ligament (middle fasciculus) with tearing off of a small fragment of bone, and so one of the more severe types of ankle injury may be overlooked. If a "chip" fracture of the fibula were known to be present, one would hesitate to recommend strapping and immediate use, or even use after three or four days. But actually this is just what occurs when these fractures are not disclosed by



3. FRACTURE SHOWN IN FIGURE 2 IS NOT DEMONSTRABLE IN THESE ASPECTS.

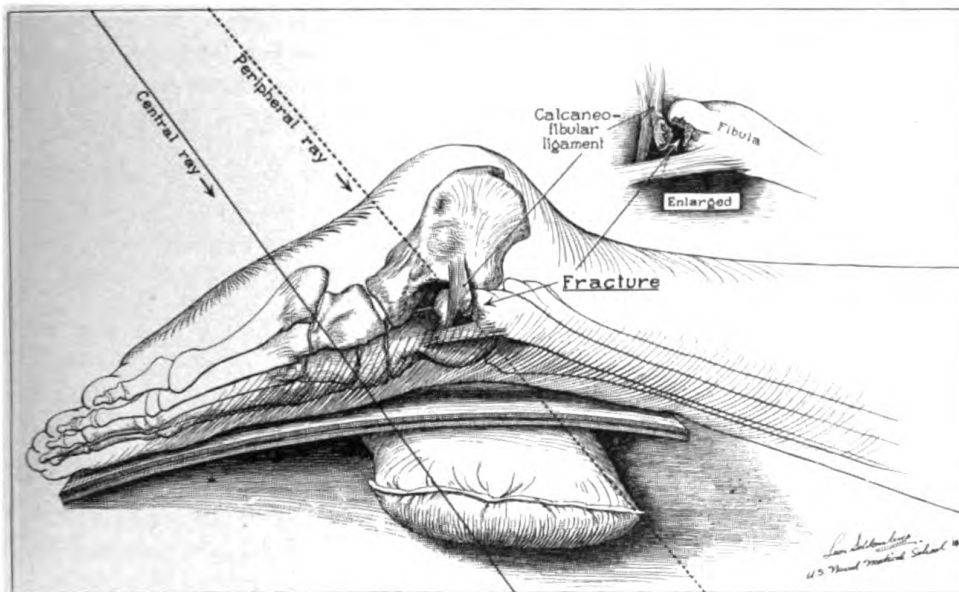
x-ray, and the physician feels confident in recommending less exacting treatment, and may even insist upon early full use of the affected part.

The technic I have followed for a number of years takes into account the demonstration of a chip fracture of the distal anterior margin of the fibula and the angles necessary for its demonstration as well as of the other types of ankle fracture. First the usual anteroposterior and true lateral views of the ankle are made. Then the patient lies prone on the x-ray table and a sandbag is so placed that the anterior surface of the ankle rests upon it. A cardboard film holder with a "plain" film in it is placed between the ankle and the sandbag so that the lower end of the holder extends about a centimeter beyond the great toe. The foot is in extension (plantar flexion). No increased pain is felt by the extension as long as the large toe does not rest on the table. The elevation produced by the sandbag is sufficient to accomplish this.

The x-ray tube is then tilted toward the head. The tilt is usually slightly greater than an angle of 90° with the dorsum of the foot.

If the central ray is directed through the dorsum of the foot and at right angles to it, then the upper marginal rays will be projected at a greater angle than 90° and will be just sufficiently tangent to the distal anterior margin of the fibula to penetrate between the detached small fragment and the shaft. The central and distal peripheral rays give an excellent image of the other bones of the foot. In fact the tarsal and metatarsal bones as well as the phalanges being actually closer to the film than with the usual technic of plantar contact, finer bone detail will be shown.

By this technic, a postero-anterior film of the foot and ankle are made. The tip of the fibula always appears on the film. It will be seen



4. SHOWING POSITIONS OF FOOT AND FILM AS WELL AS PATH OF X-RAYS TO DEMONSTRATE THE FIBULAR FRACTURE.

by reference to figure 4 that the angulation of the central ray of the tube is just sufficient to extend tangent to the site of the attachment of the anterior and middle ligamentous bands. When a bone fragment is torn off the rays pass between the fragment and the fibula, and the fracture is easily demonstrated. The technic is simple and the remainder of the film is not wasted, for a better than average view of the bones of the foot is obtained.

It is incumbent upon the physician to suspect the presence of such a ligamentous and bone injury in moderately severe sprains. It should be suspected in every severe sprain, and the fracture sought for by the appropriate technic. The demonstration of the avulsed fragment immediately tells him that the ligamentous avulsion is complete and that appropriate treatment is necessary. More than just

the routine treatment of a simple sprain is in order. Complete immobilization is quite essential. This is best accomplished in an unpadded plaster cast, with the foot in moderate dorsal flexion and the ankle slightly everted. A plaster cast is applied and immobilization is maintained for from 8 to 10 weeks. After 6 weeks the cast should be bivalved and the immobilization obtained by means of the posterior half of the cast. During this time physiotherapy should be carried out so that at the end of the immobilization period the ankle will be flexible and ready to be used in walking.



DERMATOPHYTOSIS THERAPY

In the presence of a high degree of sensitivity and an eruption which has spread to the rest of the body, it is not advisable to treat the primary lesion too vigorously. Should too vigorous treatment be instituted, there is an actual rapid killing of fungi and dissemination of their toxins with intensification of the allergic manifestations. Under those conditions it is better to use mild, wet dressings like Burow's solution or boric acid solution.

In most cases of the more chronic type, considerable experience is necessary in order to juggle the various types of therapy. The treatment is not so much a matter of a specific against fungus infections as having adequate dermatological training to treat properly a patient with dermatologic manifestations. For the non-dermatologist a good routine would be one in which the best possible prophylaxis is carried out to prevent recurrences.

It is realized that in tropical countries there may be types of fungus infections with which the authors have had no experience. It is believed, however, that since personnel being sent into tropical climates are carrying the fungus infections with them, it is possible that the problem there is not so much that of an unusual fungus but rather the effect of excessive moisture and heat, which are excellent for the propagation and dissemination of the fungi which may cause an aggravation of symptoms.—Peck, S. M., and Schwartz, L.: A practical plan for the treatment of superficial fungus infections. Pub. Health Reps. 58: 337-345, February 26, 1943.



CALCIUM AND DENTAL CARIES

Increased calcium and vitamin-D intake has not controlled dental caries, and there is no physiologic basis for assuming that it will. Bone and teeth differ in their metabolism of calcium, bone being subject to calcium withdrawal to maintain other calcium needs in the body, and the teeth retaining their calcium even in severe calcium deficiency diseases. Teeth have no vascular or cellular mechanism like that found in the tissues around bone, for osteoclastic removal of calcium.—Robinson, H. B. G.: Dental caries and the metabolism of calcium. J. Am. Dent. A. 30: 364, March 1, 1943.

PNEUMONIA ¹

A REVIEW OF 388 CASES AT THE PHILADELPHIA NAVAL HOSPITAL

FERDINAND FETTER

Lieutenant Commander (MC) U. S. N. R.

There has probably been a greater improvement, during the past few years, in both the clinical picture and the prognosis of lobar pneumonia than in any other important infectious disease. This change is due to 2 new factors in specific treatment, serum and the sulfonamides; the latter is by far the more important. Without any specific treatment the mortality of lobar pneumonia had been at least 30 percent for many years, and often higher. For example the death rate in Illinois during 1935 was 44.3 percent, and during 1936 it was 39.6 percent (1). This generally high mortality was reduced by the use of serum to 25 percent or less in a few series, before the introduction of the sulfonamides in 1937. Now, however, the proper use of these drugs plus serum in selected cases has further reduced the mortality to about 10 percent. Since the number of cases of pneumonia in the United States each year is roughly 500,000, this means that the number of deaths has been reduced from approximately 150,000 to 50,000, a saving of 100,000 lives each year.

This astounding decrease in the mortality from pneumonia is illustrated by the reports of state pneumonia-control programs in Pennsylvania (2) and Illinois (1), each series consisting of more than 15,000 cases treated since the introduction of the sulfonamides. The case fatality rate in the Pennsylvania series, with all kinds of treatment, was 9.19 percent; that in the Illinois series was practically identical, 9.2 percent. Sulfonamides alone were used in the majority of cases. On the basis of the consistent decline in the mortality rate from pneumonia down through the first 7 months of 1942, the medical statistician Dublin (3) has predicted that pneumonia, which only 10 years ago was a scourge, will soon become a minor cause of death.

DIAGNOSIS

Nothing startlingly new has been reported for many years concerning the diagnosis of lobar pneumonia. The emphasis at present is on the importance of the history and on the scarcity or absence of physical signs early in the disease. Given an acutely ill febrile patient, with a history of chill, pain in the chest, and rusty sputum, the diagnosis can almost be made without abnormal physical findings. During the first 12 hours of the disease there are, in fact, no physical

¹ Received for publication November 25, 1942.

abnormalities ordinarily present. The earliest important physical signs, which usually develop between 12 and 24 hours after the onset, are limitation of motion of the affected side of the chest, and diminished breath sounds over the involved lobe. Later, impaired resonance and subcrepitant râles during a deep inspiration or after a cough may be found. The classical signs of lobar pneumonia, dullness on percussion, bronchial breathing, and whispered pectoriloquy, are not usually found until 2 or 3 days after the onset of the disease. Incidentally, it is not uncommon for the inexperienced examiner to be misled into placing the pneumonic area on the side opposite to the actual lesion, because overactivity of the healthy lung, in trying to compensate for the diseased lobe, may produce increase in intensity of the breath sounds and even bronchovesicular breathing.

Chest x-rays are, of course, of great value in confirming the clinical diagnosis. Often the x-ray will show an early pneumonic process where the physical findings are entirely normal. The opposite is true occasionally, and a clinical diagnosis of pneumonia can sometimes be made on the basis of the history and minimal chest findings, with x-ray negative at the time. Of course serial x-rays in such cases will show the pneumonic process in the next 12 to 24 hours. While chest x-rays are desirable, they are not essential in diagnosing or treating the average case of lobar pneumonia.

CHEMOTHERAPY OF PNEUMONIA

The sulfonamides that have been used in treating pneumonia are, in order of their development, sulfapyridine, sulfathiazole, and sulfadiazine. Representative of studies on sulfapyridine and sulfathiazole is that of Flippin, Reinhold, and Schwartz (4), who stated that there was no significant difference in the mortality rates in 200 pneumonia patients given sulfapyridine, as compared with 200 patients given sulfathiazole. However, the corrected mortality rate (omitting patients who died in less than 24 hours after admission to the hospital), was 11.9 percent for the sulfapyridine-treated cases, and only 7.8 percent for the sulfathiazole-treated cases, which would appear to give sulfathiazole the advantage. The incidence of nausea and vomiting was about three times greater in the sulfapyridine group than in the sulfathiazole group. Other toxic manifestations, such as hematuria, drug fever, and dermatitis, were infrequent and similar in the 2 groups. In a recent report of the treatment of 557 cases of pneumonia with sulfathiazole, Price and Myers (5) reported an uncorrected death rate of 11.3 percent. The corresponding figure for 139 sulfapyridine-treated cases was 18.7 percent. These authors therefore considered sulfathiazole definitely superior to sulfapyridine.

In a later study of 200 patients with pneumonia, comparing sulfathiazole and sulfadiazine, Flippin and his coworkers (6) reported a corrected mortality rate (excluding 24-hour deaths) of 6.3 percent in the sulfadiazine group; in the sulfathiazole group, the corrected mortality was 11.3 percent. Toxic manifestations were low in both groups. Another paper on sulfadiazine is that of Ensworth and his associates (7), who reported a corrected fatality rate, omitting 24-hour deaths, of 10.9 percent in 239 pneumonia patients treated with this drug. The most striking results were obtained in type-2 pneumonia, of whom only 1 of 42 patients (omitting two 24-hour deaths) died. The low mortality in this group is especially striking in view of the high incidence of bacteremia, which was present in 13 of the 42 patients.

It was originally thought that the undesirable renal complications, hematuria, renal colic, anuria, and uremia, would be much less frequent with sulfadiazine than with sulfathiazole, because of the lower acetylation of sulfadiazine, and the greater solubility of acetyl sulfadiazine in the urine. However, these hopes have not been borne out. All of these complications, including deaths from anuria, have occurred with sulfadiazine (8). Furthermore, the New York Department of Health has recently decided (9) not to renew the supply of sulfadiazine to laboratory supply stations for the treatment of pneumococcal infections. This decision is based on the fact that as good results are obtained with sulfathiazole, which costs much less, and which probably produces only a few more toxic reactions.

The present status of sulfapyridine, sulfathiazole, and sulfadiazine in the treatment of pneumonia may be summed up as follows: The mortality rates are similar enough that there is no drug of choice on the basis of a lower mortality. Because of the much higher incidence of vomiting with sulfapyridine than with the other two drugs, it has been pretty well abandoned, and should be used only if one of the other two is not available. If cost need not be considered, and sulfadiazine is available, it is the drug of choice, but it produces toxic reactions often enough so that the same precautions must be taken with it as with sulfathiazole. If cost must be considered, sulfathiazole is the drug of choice.

PNEUMONIA CASES AT THE PHILADELPHIA NAVAL HOSPITAL

During the 18-month period between January 1, 1941, and July 1, 1942, 388 patients with pneumonia were treated in the wards of the Philadelphia Naval Hospital. One hundred and ninety-nine of these patients were admitted during 1941; almost as many patients, 189, were admitted during the first 6 months of 1942. The following routine was used: After the history and physical examination were com-

pleted, sputum typing, blood count, blood culture, urinalysis, and chest x-rays were done immediately, and the patient was started on a sulfonamide. The initial dose of this was 3 grams, followed by 1 gram every 4 hours day and night. If the patient was too ill to take the drug by mouth, the sodium salt was given intravenously for the first few doses, usually 2 grams every 6 to 8 hours. The drug was ordinarily continued until the temperature was below 99° F. for 48 hours. In general, if a favorable response to the drug was obtained, the temperature dropped and clinical improvement was evident within 24 to 48 hours. The average total dosage of sulfonamide per patient was 25 to 35 grams. Blood counts, urinalyses, and blood sulfonamide levels were done three times a week. The nonspecific methods of treatment, including good nursing care, the forcing of fluids, opiates or strapping of the chest for pain, and oxygen, if needed, were, of course, used along with chemotherapy. When serum was given, the initial dose was 50,000 to 100,000 units, repeated every 6 to 8 hours, depending on the clinical course, until 150,000 to 300,000 units had been given.

The distribution of the patients by months is shown in table 1. March, as was to be expected, had the largest number of cases during the first half of 1942. However, January was the peak month of 1941.

TABLE 1.—*Distribution of pneumonia cases by months*

Month	Number of cases in 1941	Number of cases in 1942	Month	Number of cases in 1941	Number of cases in 1942
January	40	37	September	14	
February	20	39	October	15	
March	15	47	November	23	
April	12	37	December	17	
May	12	15	Total	109	189
June	9	14	Grand total		388
July	10				
August	12				

The distribution by age is shown in table 2.

TABLE 2.—*Distribution of pneumonia cases by age*

Age (years)	Number of cases	Percentage of cases	Age (years)	Number of cases	Percentage of cases
10 to 19	29	7.5	60 to 69	31	8.2
20 to 29	66	17.0	70 to 79	5	1.0
30 to 39	24	6.0	80 to 89	1	.3
40 to 49	170	44.0	Total	388	100.0
50 to 59	62	16.0			

Service status.—Of the 388 patients, 140 were active-service patients and 248 were veterans. As was to be expected the percentage of active-service patients was much higher during 1942, after war had been declared, than it was during 1941. In the latter period (1941) there were five times as many veterans as service patients, 166 to 33. During

the first half of 1942 there were more service patients than veterans, 107 and 82 respectively.

Racial distributions.—Of the 388 patients, 340 were white, 46 were Negro, 1 was Chinese, and 1 was Filipino.

Anatomic type.—Three hundred eleven of the 388 cases were lobar in distribution, and the remaining 77 were bronchopneumonic in type.

Postoperative cases.—Nineteen of the patients, 4.9 percent of the total, were cases of postoperative pneumonia. Patients with postoperative atelectasis were not included. The postoperative cases are summarized in table 3.

TABLE 3.—*Postoperative pneumonia cases*

Operation	Number of cases	Operation	Number of cases
Appendectomy.....	4	Thyroidectomy.....	1
Tonsillectomy.....	4	Herniorrhaphy.....	1
Cholecystectomy.....	3	Hemorrhoidectomy.....	1
Prostatectomy.....	2		
Laparotomy (malignancy).....	2	Total.....	19
Gastroenterostomy.....	1		

Types of pneumonia.—Typable pneumococci were found in only 55 of the 199 cases during 1941, 27.5 percent of the total. The difficulties in typing were due to several factors: Delay in getting the sputum specimens to the laboratory, especially when the patient was admitted at night; trouble with the typing technic in the laboratory, due chiefly to rapidly changing personnel; the administration of a sulfonamide prior to admission, which frequently causes pneumococci to lose their type specificity; and lack of typing sera in the laboratory for several weeks. Of course, not all of the nontypable cases were pneumococcal. Complete bacteriologic studies of the sputum could not be made, because of limited laboratory personnel, so that causative organisms other than pneumococci were not found. Furthermore 18 of the 77 cases listed as bronchopneumonia were of the type now called atypical ("virus") pneumonia; pneumococci were not, of course, found in their sputa. Even considering all these factors, however, it is obvious that the results of sputum typing during 1941 do not give a correct picture of the incidence of the various types of pneumococcal pneumonia, so I am not including them in the analysis of sputum typing. During 1942 most of the difficulties with sputum typing were corrected, with fairly good results. Of the 189 cases during the first half of 1942, typable pneumococci were found in 112, or 59 percent. The distribution of the 7 common types of pneumococcal pneumonia, types 1, 2, 3, 4, 7, 8, and 14, is shown in table 4.

TABLE 4.—Incidence of the 7 common types in 112 typed cases

Type	Number of Cases	Percentage of all typed cases	Type	Number of Cases	Percentage of all typed cases
1.....	23	20.5	8.....	8	7.1
2.....	12	10.7	14.....	5	4.5
3.....	14	12.5			
4.....	5	4.5	Total.....	75	66.9
7.....	8	7.1			

Of the other higher types, there were three each of types 5, 19, and 28, two each of types 6, 10, 16, 17, 20, 24, 25, and 27, and one each of types 9, 11, 12, 13, 15, 18, 22, 23, 29, 31, 32, and 33.

This distribution of the common types of pneumonia agrees fairly closely with that reported by Stahle (2) in the Pennsylvania survey. He found that 73.1 percent of the 6,043 typed cases in his series belonged to the seven common types enumerated above, corresponding to 66.9 percent of our typed cases. Types 1, 3, and 2, in the order named, were the commonest types in Stahle's series, as they were in ours. These made up 50.2 percent of his typed cases and 43.7 percent of ours.

Bacteremic cases.—Positive blood cultures were obtained in 23 of the 388 cases, 5.9 percent of the total. In 3 of these pneumococci were found in the blood, but typing was not done. In the remaining 20 cases typing was carried out. Only three of the 23 bacteremic patients died, a mortality rate of 13 percent. Two of these three patients had type-4 pneumococcus in the blood; the other had type-3 pneumococcus.

Table 5 shows the distribution of the types of pneumococci in the bacteremic cases, and the results of treatment.

TABLE 5.—Distribution of bacteremic cases, and results

Type of pneumococcus	Number of cases	Results		Type of pneumococcus	Number of cases	Results	
		Recov-ered	Died			Recov-ered	Died
1.....	5	5		14.....	2	2	
2.....	3	3		20.....	1	1	
3.....	2	1	1	Not typed.....	3	3	
4.....	3	1	2				
5.....	2	2		Total.....	23	20	3
9.....	2	2					

COMPLICATIONS

Lung abscess.—There were four lung abscesses as complications of pneumonia, an incidence of 1 percent. This is a higher incidence than usually occurs; Cecil (10) reported only nine lung abscesses in 2,122 pneumonia patients in a Bellevue Hospital series, an incidence of 0.4

percent. All of our four patients improved with conservative treatment, including bronchoscopic drainages.

Empyema.—Seven of the patients developed empyema, an incidence of 1.8 percent. This is about the expected incidence of empyema in sulfonamide-treated pneumonia patients. Since the introduction of the sulfonamides the incidence of postpneumonic empyema has been reduced from 5–10 percent to 1–2 percent (11). All of our empyema patients were treated surgically, with open drainage after rib resection. Six of the seven recovered; the other died two months after operation, of sepsis and anemia.

Serous pleural effusion.—This minor complication occurred in 13 patients, an incidence of 3.3 percent. All of these effusions, which were sterile on culture, absorbed after one or two aspirations.

TREATMENT

In addition to the sulfonamides, which were used in all but one case, oxygen was used in 120 cases (a little less than one-third of the patients), blood transfusions were used in nine cases, and serum was used in eight cases. Of the sulfonamides, sulfapyridine was used in 115 cases, sulfathiazole was used in 270 cases (including five who received serum), and sulfadiazine was used in two cases (who also received serum). As a means of forestalling toxic reactions from these drugs, blood counts, urinalyses, and blood-sulfonamide levels were done three times a week, and a urinary output of at least 1,200 cc. each 24 hours was insisted upon. Table six summarizes the undesirable reactions from sulfapyridine and sulfathiazole.

TABLE 6.—Incidence of toxic reactions

Reaction	Incidence with sulfapyri- dine	Incidence with sulfathia- zole	Reaction	Incidence with sulfapyri- dine	Incidence with sulfathia- zole
	<i>Percent</i>	<i>Percent</i>		<i>Percent</i>	<i>Percent</i>
Vomiting.....	47.0	10.0	Drug fever.....	3.0	8.0
Hematuria.....	7.0	6.0	Conjunctivitis.....		2.6
Anemia.....	5.0	5.0	Dermatitis.....	2.6	4.2
Leukopenia.....	1.7	1.1			

In three of the patients who developed hematuria (two treated with sulfapyridine and one with sulfathiazole), cystoscopy with ureteral lavage was necessary because of oliguria; all of these patients recovered. Anemia from the drug was considered present if the hemoglobin fell below 9.5 grams, and leukopenia if the white blood count fell below 3,500. The development of either of these conditions was considered an indication for stopping the drug.

Aside from the high incidence of vomiting from sulfapyridine, the number of toxic reactions with both drugs was relatively small. None of the deaths were attributable, even in part, to the drug.

Serum.—Specific antipneumonococcus rabbit serum was used in eight patients. In six of these, it was given because the patient failed to improve, and remained seriously ill after 24 to 48 hours treatment with a sulfonamide. In one patient a persistent leukopenia (the initial white blood count was 1,750) was an additional indication for serum, which was started 18 hours after failure to improve with sulfathiazole. In the last case, serum was given instead of sulfathiazole because the patient had aplastic anemia from benzene poisoning, before the development of the pneumonia. Table 7 summarizes the cases treated with serum.

TABLE 7.—*Pneumonia cases treated with serum*

Type of pneumococcus	Blood culture	Indication for serum	Total serum units	Result
1.....	Negative..	Failure to improve with sulfonamide.....	410,000	Cure.
1.....	Positive..	do.....	220,000	Do.
1.....	Negative..	do.....	80,000	Do.
1.....	do.....	do.....	200,000	Do.
1.....	Positive..	do.....	200,000	Do.
1.....	Negative..	do.....	320,000	Do.
4.....	Positive..	Failure to improve with sulfonamide, and leukopenia (WBC 1,750).	200,000	Death.
14.....	Negative..	Aplastic anemia (WBC 2,000).....	140,000	Cure.

DEATHS

Of the 388 patients, 35 died, a mortality rate of 9 percent. Six of these 35 patients died in less than 24 hours after admission to the hospital. If these are excluded the number of deaths is 29 and the mortality rate is 7.5 percent. All deaths were in veterans, and none were in active-service patients. Autopsies were performed in 17 cases, slightly less than half of the deaths. Table 8 summarizes the mortality rates with the various kinds of treatment.

TABLE 8.—*Mortality with various kinds of treatment*

Treatment	Number of cases	Number of deaths	Mortality rate (uncorrected)	Number of deaths within 24 hours	Mortality rate excluding 24-hour deaths
			Percent		Percent
All types.....	388	35	9.0	6	7.5
Sulfapyridine.....	115	15	13.0	3	10.4
Sulfathiazole.....	265	19	7.1	3	6.0
Serum and sulfonamide ¹	8	1	12.5		

¹ One of these patients, the aplastic anemia case, received serum only.

Factors influencing mortality.—The mortality rate is seen to be lower with sulfathiazole than with sulfapyridine. However one cannot jump to the conclusion that the former drug is more effective than the latter, as the types of patients treated with the two drugs were some-

what different. Sulfapyridine was used during the first 8 months of 1941, when the great majority of patients were veterans, who were in the older age group. After September 1941, when sulfathiazole was used, the number of younger active-service patients increased up to more than half the total. Further it should be recalled that all of our deaths occurred in veterans. The mortality from pneumonia in naval service patients has been much lower than in the population at large, doubtless due to the facts that the patients come from the younger age group, and are a selected group of particularly healthy individuals to begin with. This low mortality is shown in table 9, the data for which were taken from the Statistics of Diseases and Injuries in the Navy for 1940 (12).

TABLE 9.—*Pneumonia statistics in the Navy for 1940*

Form	Number of cases	Deaths	Mortality rate	Average of preceding 9 years
			Percent	Percent
Lobar.....	367	10	2.7	15.8
Broncho.....	216	6	2.8	11.7
Total.....	583	16	2.7	

Navy statistics show further that while pneumonia and influenza, which are grouped together, were the third most common cause of death in 1936, they had dropped to seventh place in 1940.

Before the introduction of the sulfonamides it was the previously healthy young adults who were apt to die of pneumonia. Now it has been found that most deaths occur in infants under 1 year of age and in adults over 50 years. The youngest patient in our series to die was 43 years and 19 of the 35 deaths occurred in patients over 50 years.

In addition to the age factor, the presence of complicating diseases has an adverse effect on the mortality from pneumonia. Some complicating disease was present in all but 4 of the 35 deaths in this series. These are summarized in table 10.

TABLE 10.—*Complicating diseases in fatal cases*

Complicating disease	Number of cases	Complicating disease	Number of cases
Heart disease.....	13	Empyema.....	1
Alcoholism.....	8	Cirrhosis of liver with hematemesis.....	1
Cerebral vascular accident.....	3	None.....	4
Bronchial asthma.....	3		
Bronchiectasis.....	2	Total.....	35

Bacteremia has also been considered an important factor in pneumonia mortality. Stahle (2) found the mortality rate in bacteremic cases to be 3 times that in the nonbacteremic (29.5 percent and 9.2 per-

cent), and in Flippin, Reinhold, and Schwartz's (4) series of 400 patients, the mortality rate in the bacteremic patients was very high, 42 percent. In our series, however, only 3 of the 23 patients with positive blood cultures died, giving a mortality rate of 13 percent, which is only a little higher than the general mortality rate of 9 percent. However, the small number of bacteremic patients in this series makes these findings less conclusive than those in larger series.

THE PLACE OF SERUM IN THE TREATMENT OF PNEUMONIA

There has been a good deal of discussion as to the place of serum in the treatment of pneumonia. There is no doubt that prior to the introduction of the sulfonamides, the preparation of rabbit serum against all of the types of pneumococcal pneumonia was the greatest advance in the specific treatment of this disease. However serotherapy has certain obvious disadvantages, the most important of which are:

1. Need of accurate sputum typing.
2. Serum reactions.
3. Technical difficulties in serum administration.
4. Cost of serum (about \$50.00 per patient).

A sulfonamide given by mouth has none of these disadvantages except that of producing undesirable reactions in some cases.

There are conflicting opinions in the literature as to the indications for serum in pneumonia. Dowling and his coworkers (13) reported a series of 162 pneumonia patients in which alternate cases were given serum and sulfapyridine, and sulfapyridine alone. There was a 9.8 percent mortality rate in the former group, and a 12.5 percent mortality rate in the latter. These workers felt that serum was a definite advantage and that it should be used almost routinely in pneumonia patients over 40 years of age seen during the first 4 days of the disease, and in all other patients who were seriously ill when first seen. On the other hand, Plummer and his associates (14), in a series of 607 cases of pneumonia treated at Bellevue Hospital, alternate cases being given sulfonamide alone and sulfonamide plus serum, found the mortality rate in the drug-only group to be slightly lower, 11.1 percent, than that in the drug plus serum group, 14.6 percent. They were constantly on the lookout for patients who received the drug alone to whom they had done an injustice in not giving serum, but on analyzing the completed data, they found none. In both of the large series from Pennsylvania (2) and Illinois (1) already referred to, the mortality was higher in patients who received serum than in the general average and in those who received drug

therapy only, but this was doubtless due to the fact that serum was reserved for the patients most seriously ill.

The present status of serotherapy in pneumonia can be summarized as follows: Serum is indicated (1) in patients who cannot take sulfonamides because of known intolerance or idiosyncrasy; (2) in patients who are not responding to a sulfonamide within 24 to 48 hours and are still seriously ill; (3) in patients who are critically ill when first seen; and (4) in patients with positive blood cultures who are seriously ill. Some men also believe that serum is indicated in all type-3 pneumonias because of the higher mortality in this than in other types.

Once it has been decided that serum is indicated, there should be no delay in its administration. For this reason it is desirable that adequate supplies of serum be on hand at all naval hospitals in the temperate zones, where pneumonia is endemic. The minimum necessary antisera are those for the seven common types of pneumonia, 1, 2, 3, 4, 7, 8, and 14. The other types of pneumonia are sufficiently rare so that it is ordinarily safe to rely on outside sources for sera for them.

ATYPICAL ("VIRUS") PNEUMONIA

Eighteen of the 77 cases listed as bronchopneumonia were of the type known as virus or atypical pneumonia. None of these patients died. Reimann (15) in 1938 first considered a virus to be the cause of this type of pneumonia. More recently however the Surgeon General of the Army (16), and Reimann (17) himself have considered that a virus has not been proved to be the causative agent, and have advised that the disease be called atypical pneumonia, etiology unknown. By whatever name it is called this is a definite clinical entity which differs from pneumococcal pneumonia in the following respects:

1. The onset is insidious rather than rapid.
2. Pleural pain is usually absent.
3. Sputum appears late in the disease and is mucoid and tenacious rather than rusty.
4. Examination of the sputum by ordinary bacteriological methods shows no causative organisms.
5. The white blood count is usually within normal limits, instead of there being a leukocytosis.
6. The physical signs over the involved lung are minimal throughout the course of the disease.
7. The chest x-ray shows more extensive involvement (of the pneumonitic rather than the pneumonic type) than the physical examination would indicate.
8. The sulfonamides do not affect the course of the disease and are therefore not indicated in its treatment.
9. The disease is relatively mild, with a very low mortality rate, but the course is prolonged, and the convalescence slow.

SUMMARY

During the 18-month period between January 1, 1941, 1942, 388 patients with pneumonia were treated in the Philadelphia Naval Hospital.

The mortality statistics, including patients who died within 48 hours of admission to the hospital, are as follows: Within 48 hours of treatment, the mortality rate in the 388 patients was 9 percent; in 115 patients treated with sulfapyridine, the mortality rate was 10 percent; in 265 patients treated with sulfathiazole, it was 8.5 percent; and in 8 patients treated with serum, it was 12.5 percent.

Of the factors that influence the mortality rate adverse to treatment, age over 50 years and the presence of complicating diseases were the most serious.

Sulfathiazole is superior to sulfapyridine in the treatment of pneumonia chiefly because it produces nausea and vomiting less often. When cost need not be considered, and sulfadiazine is available, this is the drug of choice because it produces fewer toxic reactions than sulfapyridine or sulfathiazole. However sulfadiazine should be given with the expectation that undesirable reactions will occur.

The important indications for serum in the treatment of pneumonia are:

1. Inability of a patient to take a sulfonamide because of toxicity.
2. Failure to improve after 24 to 48 hours of sulfonamide treatment with the patient still seriously ill.
3. Critical illness when the patient is first seen.

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PATHOLOGICAL LESIONS OF ARTERIES

The pathological lesions found in these arteries are: (1) Fibrosis; (2) hyalinization; (3) atherosclerosis; (4) calcification; (5) embolism. Some investigators believe that the inciting factor is a lipoid dyscrasia. According to this hypothesis, the earliest vascular lesion is the presence of large cells containing fine lipoid granules immediately beneath the endothelium of the arteries. These lipoid cells, believed to originate in the reticuloendothelial system of the liver and adrenals, selectively invade the walls of the coronary arteries and to a much greater extent, the wall of the aorta.

Youth reacts to the presence of lipoid cells in the arterial wall by the laying down of connective tissue which produces a narrowing of the vascular lumen.

In older individuals the atheromatous abscess is the characteristic lesion.

Death may be produced by the formation of a thrombus in the lumen of the coronary arteries, by the rupture of an atheromatous "abscess," by spasm of the muscular arteries, or by ventricular fibrillation induced by overexertion in a heart with damaged coronary arteries.—Maxwell, E. S.: The pathology of coronary disease. *Kentucky M. J.*, 41: 79-82, March 1943.

EFFORT SYNDROME OR NEUROCIRCULATORY ASTHENIA IN THE NAVY

ARTHUR M. MASTER
Commander (MC) U. S. N. R.

In the Navy the terms effort syndrome and neurocirculatory asthenia are the ones in common use but the symptom complex is occasionally hidden by other diagnoses, as for example, constitutional psychopathic state, psychoneurosis, cardiac neurosis, cardiac disorder, functional tachycardia, angina pectoris, or carotid sinus syncope. Still other terms by which effort syndrome or neurocirculatory asthenia has been known are Da Costa's disease, disorderly action of the heart, and irritable heart of soldiers.

Many definitions have been given. In this report I will confine myself to the slender or asthenic type of individual with a low diaphragm and small heart. He characteristically complains of tiredness on effort, shortness of breath, palpitation, pain in the precordial region; he is nervous, perspires easily on emotion or excitement; his heart rate may be rapid, and he may possess cold clammy hands and show a tremor. In fact, the presence of these symptoms and signs should remind the examiner to search for the small heart by x-ray film or fluoroscopy.

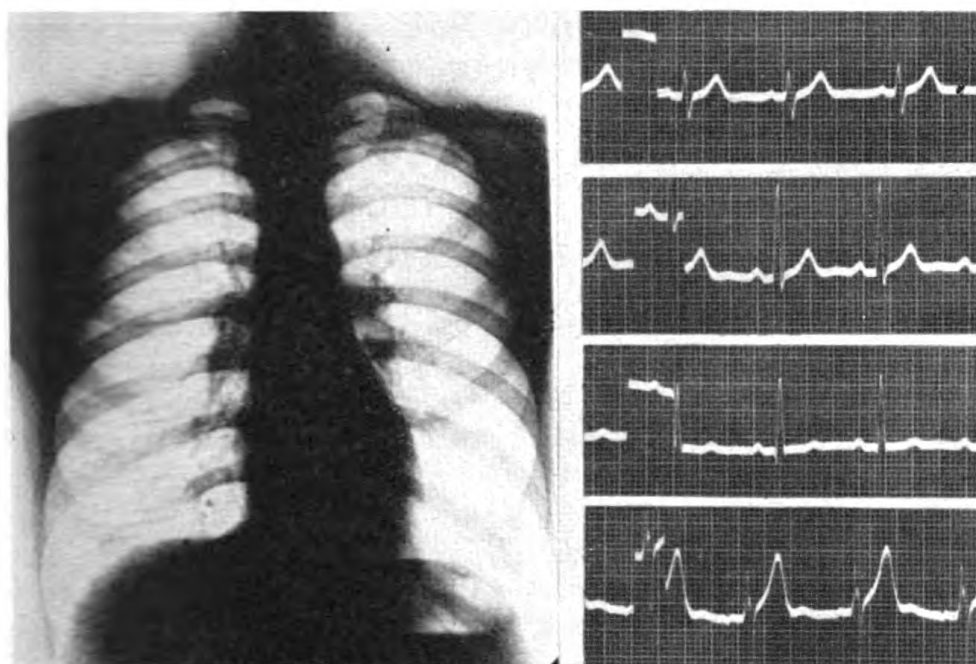
In 4 naval hospitals on the west coast I saw 30 such cases. It is not my purpose to enter into a detailed description of effort syndrome. This has been done well by others: Da Costa (1), Oppenheimer (2), Lewis (3) and White (4). The 30 cases were young men 18 to 34 who broke down at training camp and on board ship usually long before they reached the actual combat zone. There may have been precordial pain, fatigue or weakness; palpitation, orthopnea or dyspnea; a finding of tachycardia or mild hypertension; dizziness, smothering sensation, shaky feeling or trembling, and perhaps in some a story of a fainting spell on standing. There was an inadequacy for the war emergency and there was a definite history in practically every case of this inadequacy previous to enlistment.

The majority broke down a few days to a few months after enlistment, usually at the receiving station. A few actually reached the scene of combat. One was in the Coral Sea battle and suffered compression although there was no evidence of any actual injury from depth bomb explosions. Occasionally there was a story of an upper respiratory infection but usually the hard physical grind of the training camp, or of active service caused the break-down. In other words while these men could overcome their disability in peacetime it was not so in the war. In civil life if a boy cannot make good in one field

he enters another; if his work is too strenuous, or standing at a counter or machine is too exhausting, he takes a less fatiguing or more sedentary job.

The 30 men studied were of the slender type with labile pulse and blood pressure, with a low diaphragm, a small heart on x-ray, and a characteristic electrocardiogram (fig. 1). The electrocardiogram was typical, showing a small QRS-1 and tall QRS-2 and 3. Occasionally there was a tendency to a right axis deviation (5).

The concept of an organic basis for neurocirculatory asthenia is not new. The neuropsychiatrist Lewis (6) suggested in 1923 that persons with this syndrome had congenitally small hearts. In his opinion



1. J. G. J., AGE 19 YRS., PVT. USMC. ENLISTED APRIL 3, 1941, FEBRUARY 1942, AFTER STRENUOUS PHYSICAL EXERCISE WHILE ON DUTY IN THE SOUTH PACIFIC HE DEVELOPED PRECORDIAL PAIN AND SHORTNESS OF BREATH, HE WAS SURVEYED OUT JUNE 19, 1942. TELEOROENTGENOGRAM DISCLOSED A DEPRESSED DIAPHRAGM AND A SMALL HEART. THE ELECTROCARDIOGRAM SHOWED A SMALL QRS-1 AND A TENDENCY TO RIGHT AXIS DEVIATION. THE FINDINGS ON BOTH THE X-RAY FILM AND THE ELECTROCARDIOGRAM WERE TYPICAL FOR EFFORT SYNDROME (NEUROCIRCULATORY ASTHENIA).

the hypoplasia of the heart accounted for the inadequacy of the circulatory responses and this inadequacy of functional response to effort reduced the threshold to anxiety in these patients.

Evidence that effort syndrome is of organic nature was given to me at Mare Island by Dr. Alexander MacLean (7), who had been interested in this type of patient and had made numerous observations with a modification of the Flack test. He found that if such a patient stood and blew for 10 seconds with a mercury manometer, keeping the pressure at 30 mm. Hg., the radial pulse entirely disappeared—an occurrence not observed in normal individuals. Occasionally such a

patient would faint. In other words MacLean concluded that there was an insufficient venous return to the heart which accounted for the poor response of these persons to effort.

It is well known (5) (8) that where asthenic persons with small hearts change from the recumbent to the sitting or standing position, the T-waves may become inverted. This may be considered further proof that the circulation is insufficient in the sitting and standing positions. The work of Hicks, Christian, and Smith (9) who found a decreased oxygen saturation of the blood in patients with neurocirculatory asthenia, tends to support the hypothesis of an inadequate circulation.

Direct estimates of the minute circulatory volumes (or cardiac output) were made by Starr and Jonas (10) at the University of Pennsylvania. Their studies showed that most patients with neurocirculatory asthenia had cardiac output below the average. They used the ballistocardiographic method. The inability of the heart of patients with neurocirculatory asthenia to deliver a normal cardiac output is further evidence of an organic defect.

During 1942 my colleague, Dr. Ralph Parker, and I have seen numerous officer candidates of the effort-syndrome type in consultation at the National Naval Medical Center. We performed complete physical examinations, took x-ray films of the chest, made electrocardiographic tracings, performed the standard "2-step exercise," including the "electrocardiogram after the 2-step exercise" (11). In practically every instance the blood pressure and pulse rate response lagged (i. e., did not return to within 10 points of resting levels in 2 minutes after completion of the exercise). This indicated an inability of the vasomotor centers in the brain and elsewhere adequately to supply the skeletal muscles on exercise. The cardiac output may have been insufficient. The electrocardiograms after the "2-step," which are consistently unchanged after this exercise in normal individuals, frequently were positive (i. e., showed RS-T depressions and T-wave inversions). These changes indicate inadequate coronary blood supply to the heart muscle. That they were indicative of anoxemia was proven by the fact that the same electrocardiographic abnormalities appeared after breathing diminished oxygen (10 percent). One of our patients, a photographer, suffered from his break-down at the time of his first flight to high altitude, an occurrence which strongly suggests that anoxemia may be an important factor.

In summary a group of patients of asthenic physique with small hearts and the symptoms of neurocirculatory asthenia has been reviewed. The patients in this group at the west coast hospitals were unable to stand the physical, emotional and mental stress of the war. In every case on personal questioning, on Red Cross investigation, by correspondence with the families, these men gave a clear-cut story of inadequacy preceding enlistment if not throughout the entire life.

The research at the National Naval Medical Center together with evidence already extant indicates that these men possess a constitutionally small heart which does not eject enough blood per minute to nourish the heart, skeletal muscles and organs of the body adequately in response to effort. These men should not be accepted in the Navy.

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DIARRHEA

Diarrhea has been defined as "a morbid frequency in bowel evacuation due to diet, irritation or inflammation of the mucous membranes of the intestines." There are various causes of the irritation of the lining of the intestinal walls which gives rise to the too-frequent, watery stools. It may be that the diarrheal condition is a symptom or a complication of some other disease; or it may be caused by wrong diet, excessive use of purgatives, or by bacterial action.—Proudfit, F. T.: *Diet in Diarrhea and Other Intestinal Disturbances*. Nutrition & Diet Therapy, Eighth Edition: 524-550, 1942. The Macmillan Company, New York, New York.

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INJURIES OF THE HEAD¹

EVALUATION AND MANAGEMENT

JOSEPH H. SIRIS

Lieutenant (MC) U. S. N. R.

The period elapsing since the previous world conflict has witnessed significant developments that have served to alter many aspects of the problem of craniocerebral injury. Pathophysiology, diagnosis, and treatment have all undergone changes of concept, which make the management of head injuries appreciably different from that which obtained prior to the heightening of interest in problems of traumatic neurosurgery. Among the developments motivating such changes have been researches in cerebral physiology and metabolism, the recognition of subdural hematoma as a traumatic entity, the advent of encephalography, the utilization of chemotherapy, improved methods of handling associated shock, and the refinement of electrosurgical methods allowing for more extensive intracerebral procedures.

PATHOPHYSIOLOGY

The threat to the integrity and life of any individual who has sustained an injury to the head is obviously in direct ratio to the degree of impairment of cerebral function. This in turn is an expression of brain damage with resultant cerebral hypoxia and altered intracranial tension, a varying combination of which is apt to exist in any given case. The actual responsible factor, i. e., hypoxia or altered tension, has not been thoroughly settled, but a body of experimental and clinical evidence has been steadily accumulating to indicate that the untoward manifestations are intimately linked with a failure of cerebral oxidation.

The role of intracranial hypertension and its effect on the circulatory system was first emphasized in the experimental work of Kocher, whose postulates subsequently governed the management of clinical material. Increasing intracranial tension beyond that of the diastolic pressure was found to effect a slowing of the pulse and elevation of the blood pressure. Such intracranial pressures, however, are practically never maintained in the human subject. Even in the severest types of brain injury, the intracranial pressure as evidenced by lumbar manometry rarely exceeds 600 mm. of water (46 mm. Hg.). Experimental studies nevertheless indicate that a rise of intracranial tension to a point considerably in excess of the systolic blood pressure does occur momentarily following a head blow sufficient to cause un-

¹ Received for publication November 25, 1942.

consciousness, with a subsequent prompt return of intracranial pressure to normal (1). The loss of consciousness presumably results from cerebral hypoxia with temporary alteration of brain metabolism (2). It is known that the cerebrum is extremely sensitive to oxygen deprivation and that carbohydrate is the essential foodstuff oxidized by the brain. This metabolic process appears to require the presence of Vitamin B₁ in order to proceed normally. Ordinarily the oxygen difference between intracranial arterial and venous blood is about 7 volumes percent. If as a result of cerebral insult there is an inability to utilize dextrose or oxygen, this difference is materially reduced and coma ensues (3). The critical difference below which serious symptoms supervene is in the neighborhood of 4 volumes percent. Though the actual extent of cerebral hypoxia associated with brain injury has not been worked out, the existence of ischemic changes is well enough established from pathological studies.

The available evidence furthermore suggests that the production of unconsciousness requires an alteration of the brain's metabolism generally rather than locally. It is not exceptional for consciousness to be retained with well localized penetrating brain wounds. On the other hand, instances of profound unconsciousness due to head injury without associated skull fracture are frequently seen. In such cases it appears probable that the injury is diffusely transmitted to many areas of the brain and that the resultant unconsciousness may be an expression of rapid acceleration of the various cerebral centers as suggested by Denny-Brown and Russell (4).

CLASSIFICATION—DIAGNOSIS

The soundness of any classification of cranio-cerebral injuries consists, in the final analysis, in its ability to enable the individual responsible for the management of a given case of head trauma to decide whether urgent surgical intervention is indicated. Munro (5) has satisfied this criterion in devising a classification based on therapeutic considerations, the aim of which is to divide patients into operable and nonoperable groups. Experience with this basic classification confirms its broad applicability to the diagnostic and therapeutic problems ordinarily encountered (table 1).

TABLE 1.—*Classification of injuries of the brain and its coverings*

(Modified from Munro)

NONOPERABLE

1. Cerebral concussion.
2. Cerebral edema and congestion.
3. Subarachnoid hemorrhage.
4. Cerebral contusion.
5. Cerebral laceration.

OPERABLE

URGENT

Open wounds:

1. Laceration of scalp.
2. Compound fracture of skull.
3. Compound laceration of dura mater and/or brain.
4. Penetrating wounds of brain.

Focal intracranial bleeding:

1. Intracerebral hemorrhage.
2. Subdural hemorrhage.
3. Extradural hemorrhage.

NONURGENT

1. Depressed fracture of skull.
2. Osteomyelitis of skull.
3. Brain abscess.
4. Pneumocephalus and cerebrospinal fluid rhinorrhea.
5. Carotid-cavernous aneurysm.

1. *Cerebral concussion*.—Many different varieties of head injury are customarily referred to by this term. It is desirable, for purposes of accurate classification, however, to restrict the term to a single clinical condition. It is preferably used for the simplest and most benign variety of intracranial injury one encounters. Clinically this is the type of head blow characterized by an impairment of consciousness (varying from a dazed state to actual unconsciousness) of variable duration, followed by prompt and complete recovery. Concussion, uncomplicated by any other form of brain damage, is comparatively rare, and probably in the majority of instances is handled outside the hospital. In the sense here described, the condition is compatible with a reversible pathophysiologic process obtaining in the brain of the patient at the time consciousness is impaired. An indication of what transpires under such circumstances is afforded by the work of Ricker (6). Invoking his conception, one may regard clinical concussion as involving paralysis of the cerebral neurovascular mechanism with resultant vascular stasis and cerebral hypoxia, but without progression to the stage of diapedesis of blood cells and irreversible cortical petechiosis, such as is seen postmortem.

2. *Cerebral edema and congestion*.—This state is superimposed upon concussion and differs from it in that impairment of consciousness is not followed by prompt recovery. Headache and vomiting are apt to be prominent symptoms when once the patient regains consciousness. No abnormal signs are ordinarily elicited on neurological examination, though papilledema may occasionally be present. The intracranial pressure, as measured by lumbar manometry, may or may not be raised. These findings, in a general but not infallible way, parallel the extent of elevation of intracranial tension.

3. *Traumatic subarachnoid hemorrhage*.—Such bleeding, uncomplicated by intrinsic trauma to the brain, is rare. Evidence of concomitant cerebral edema and congestion is the rule. As in the case of spontaneous subarachnoid hemorrhage, the clinical picture is characterized by impairment of consciousness, followed by signs of menin-

geal irritation, most notably nuchal rigidity. The diagnosis, while readily made without lumbar puncture, should not be regarded as absolute unless confirmed by the demonstration of blood in the cerebrospinal fluid.

These three aforementioned entities differ from other injuries of the brain and its meningeal coverings in the absence of evidence of focal damage, i. e., one is unable to demonstrate any abnormal neurologic signs referable to the motor or sensory spheres. They represent uncomplicated diffuse cerebral disturbance, in contrast to those varieties characterized by focal as well as diffuse brain damage. Affective and intellectual disturbances may be present. This is consistent with the concept tending to regard such functions as diffusely represented in the cortex.

4. *Cerebral contusion*.—Injury of this type, though of a focal nature, is generally associated with evidence of diffuse damage. After consciousness is regained, headache and vomiting are apt to make their appearance. Examination usually discloses evidence of focal damage. There may be motor palsies, abnormal reflex changes, disturbances of sensation, etc. Such signs tend to clear up within a period of a few days to a month. The cerebrospinal fluid is apt to be under moderately increased pressure and free of macroscopic blood.

5. *Cerebral laceration*.—This differs from cerebral contusion largely in degree rather than in kind. Unconsciousness is apt to be prolonged. Associated flaccidity and areflexia may be present initially. As consciousness is regained, pressure symptoms may appear transiently and signs of focal damage can generally be demonstrated. Such signs clear up slowly and at times incompletely. A lumbar puncture will frequently reveal bloody cerebrospinal fluid under increased pressure.

The distinction between brain laceration and severe contusion with associated subarachnoid hemorrhage is not always possible. Occasionally one is confronted with a further differentiation of these conditions from that of a cerebral vascular accident precipitating injury to the head. The clinical pictures presented by each of these problems can be identical and differential diagnosis impossible. The clinical distinction, however, is of only academic importance since treatment is substantially the same in each of these conditions.

OPERABLE INJURIES

The urgently surgical group.—There are two categories of injury comprising this group. One includes the various types of open wounds with or without direct brain communication, where diagnosis is not a problem. Of greater importance, from the standpoint of immediate threat to life itself, are cases of massive focal intracranial hemorrhage.

These are of three varieties:

1. *Focal intracerebral hemorrhage*.—This condition is characterized by the appearance of signs of focal damage, often without associated subarachnoid bleeding. The symptoms may not appear for some time following injury. Without auxiliary diagnostic measures the diagnosis can only be inferred because of the occasional striking similarity to cerebral contusion and laceration, and to extradural and subdural hemorrhage.

2. *Subdural hemorrhage*.—On clinical grounds, one is justified in distinguishing acute, subacute and chronic varieties of this condition. In the former the lesion is apt to be associated with extensive damage to the brain and skull, and bleeding into the subarachnoid space. It may closely simulate the picture of extradural hemorrhage. Occasionally, diagnosis without trephination is impossible. Under such circumstances definite criteria indicating the need for such study are available. These are discussed elsewhere. The evaluation of associated brain trauma is an important consideration since it is often sufficient to bring about a fatal issue, despite evacuation of the hemorrhage.

The subacute and chronic varieties of subdural hematoma may differ from the acute form in the relatively slight trauma required to produce them. It appears probable that the condition results in many instances from a tear of a tributary of one of the venous sinuses, and that as a result of fibroblastic proliferation from the surrounding meninges the hematoma is ultimately encapsulated within a semi-permeable membrane. The continued growth of the tumor long after the bleeding has ceased is attributable to its high colloid content and resultant high osmotic pressure.

Symptoms as a rule appear anywhere from a few days to a few months following injury. A dilated pupil is occasionally demonstrable on the side of the lesion, but cannot be depended upon for localization, since at times it is found on the opposite side. Of considerable interest is the fact that despite the lack of bilateral signs, a subdural hematoma may be present over each cerebral hemisphere in an appreciable number of cases. Of interest too is the occasional occurrence of the lesion on the side contralateral to that which the clinical picture would have rendered suspect. This has been reasonably attributed to contre-coup pressure of the opposite cerebral peduncle against the tentorium. These anomalous features are to be found in the acute, subacute and chronic lesions. It is for these reasons that it has become sound neurosurgical practice, whenever a subdural hematoma is suspected, to perform bilateral diagnostic trephination, even if a hemorrhage is disclosed on the first side examined.

3. *Extradural hemorrhage*.—Bleeding of this variety results most frequently from a transverse fracture of the squamous portion of the temporal bone. Absence of such evidence by x-ray, however, while strongly militating against the possibility of this type of hemorrhage, must not be construed as absolutely ruling it out. Nor is it safe to base the diagnosis on the combination of a lucid interval, homolaterally dilated pupil and contralateral palsy. The pupils may be equal. Hemiparesis may not be demonstrable. The cerebrospinal fluid may be clear or bloody; its pressure may or may not be elevated. The lesion should not be considered as excluded by unilateral trephination, since in an appreciable number of cases it is contralateral to the dilated pupil and homolateral with respect to the associated hemiparesis.

Pachymeningeal hemorrhage.—Just as the differential diagnosis between cerebral contusion and cerebral laceration is not always possible and is of only academic importance, the distinction of the various forms of focal intracranial hemorrhage is often impossible, due to the strikingly similar clinical picture obtainable in each. It is evident too, that in many instances an absolute differential diagnosis on strictly clinical grounds between a hemorrhagic or surgical focal lesion and a nonsurgical focal lesion, such as a contusion or laceration, is not to be expected. Under such circumstances the need for diagnostic trephination becomes evident. The procedure is readily carried out under local anesthesia. It is important that definite criteria be available to determine the indications for this type of study in any instance. Perhaps the safest rule is to reserve the procedure for cases showing at least one or more of the following indications, bearing in mind that it is the combination of criteria rather than the utilization of any single one of them that serves to determine the need for trephination in a given case:

- (a) Persistently elevated cerebrospinal fluid pressure.
- (b) Advancing or persistent papilledema.
- (c) Focal weakness.
- (d) Unilaterally dilated pupil.
- (e) Post-traumatic lucid period, followed by impaired consciousness.
- (f) Persistent impairment of consciousness and/or progressive downhill course.
- (g) Convulsions appearing for the first time soon following injury and persisting.
- (h) Persistent headaches and vomiting.

Since severe cerebral contusions and lacerations with progressively downhill course are more numerous than cases of focal intracranial hemorrhage requiring evacuation (the latter constituting less than 5 percent of brain injuries), it is evident that diagnostic trephination will be indicated in more instances of injury without massive hemorrhage than in cases in which such lesions are present. It is also

apt to be that in a few instances of pachymeningeal bleeding the lesion will not be exposed by temporal trephination, since a small number of extradural and subdural hemorrhages result from lesions such as lateral sinus tears, and localize over the cerebellum and/or occipital cortex. More rarely such hemorrhages occur in the frontal and basal regions. Consequently it is advisable in cases where the lesion is not exposed temporally and where the surgeon feels reasonably certain, on the basis of clinical evidence, that a pachymeningeal hemorrhage is probable, to make occipital openings which in the event no hematoma is found can be utilized for ventriculography. The clinical features suggesting pachymeningeal bleeding due to a lateral sinus tear are the relatively slow progression of symptoms as compared with what obtains in arterial bleeding, the presence of Battle's sign, nuchal rigidity, and x-ray evidence of a fracture of the occipital bone extending into the base of the skull.

EXAMINATION

The first diagnostic step in any given case of head injury is the neurological examination, which is sufficient to decide the question of operability or nonoperability in the majority of instances. A lumbar puncture contributes knowledge as to the extent of elevation of cerebrospinal fluid pressure and the presence of subarachnoid bleeding. Such information is of distinctly limited value, however, since in both the operable and nonoperable types of focal intracranial injury, the cerebrospinal fluid may be clear or bloody and its pressure elevated or low. Our practice has been to have such a diagnostic study if possible during the second 24-hour period following injury, at which time maximal information at relatively little added hazard to the patient can be obtained. The finding of a distinct elevation of pressure merits repetition of the study, since persistent increase of tension in conjunction with other signs, constitutes reasonable evidence for a sizeable clot.

As is generally known, radiographs indicating skull fracture are of value essentially in confirming other evidence of cerebral damage. Consequently such study may well wait until the patient is ready for discharge. There are exceptions however where earlier roentgenography may be indicated, namely in depressed fractures, penetrating wounds, and suspected extradural hemorrhage. In the latter situation, if the diagnosis is very much in doubt, a lateral skull film can be of some help, since this condition without fracture of the ipsilateral vault is relatively rare. Furthermore, the demonstration of an occipital fracture may help make the diagnosis of a posterior extradural hemorrhage due to a lateral sinus tear.

Pneumoencephalography is occasionally of value in the diagnosis of focal hemorrhage, particularly following the subsidence of the

acute phase of injury. During the acute stage, however, a simple diagnostic trephination without air injection is apt to be sufficient.

TREATMENT

The commoner therapeutic problems may be considered in order of urgency:

1. *Immediate considerations.*—These are concerned essentially with the arrest of bleeding from scalp wounds and the treatment of shock. It is not necessary that hemorrhage be arrested by prompt suture, particularly since it may be simpler to accomplish the immediate need by the application of a firm pressure dressing. If at all possible, however, scalp lacerations should receive early preliminary treatment by clipping or shaving the hair around them, followed by cleansing of superficial debris. If there is evident contamination, sulfanilamide powder should be applied locally and 1,500 to 3,000 units of tetanus antitoxin should be administered. Such measures, however, may be delayed if it is not feasible to institute them promptly.

Shock is rarely due to the injury to the head. It results generally from associated wounds and its treatment is essentially the same as that of shock unassociated with head injury, namely, the use of the Trendelenburg position, the application of warmth, and the restoration of blood volume by intravenous fluid administration.

2. *First 24 hours.*—All open head wounds should be treated within this period, preferably as soon as possible following recovery from shock. Unless such a case cannot be treated within 24 hours a primary closure is invariably indicated. The shaved scalp around the wound is prepared with iodine, following which novocaine field block is carried out. The use of general anesthesia is avoided if possible. When dural and brain penetration are present, an early intracerebral debridement is indicated to circumvent infection. Cases first seen beyond the 24-hour period are customarily not closed per primum, but treated instead as potentially infected wounds. The increased use of sulfonamides, however, may permit a modification of this practice in selected cases.

Extradural hemorrhage is, as a rule, best treated within the first 12 hours. The operative mortality is almost in direct ratio to the period elapsing from the time of injury. In contrast to the problem presented by subdural bleeding, it is insufficient here merely to evacuate the clot. Bleeding points should be found and closed. An occasional case, particularly of the variety in which bleeding is venous rather than arterial, will show a less fulminating clinical picture, and the results of operation, though undertaken late, will be good.

3. *After first day.*—Included within this group are the uncompounded depressed skull fractures, and to some extent acute subdural hematomas. The former involve less a decision as to operability than

as to the optimal time to operate. Since the maximal damage has already been done at the time the depression is made, and since the depression of itself involves no threat to life, elevation can be delayed until the patient is in a satisfactory condition. Depressed fractures of slight degree, particularly if only of the outer table, can generally be disregarded. Sizeable depressions, in view of the high incidence of post-traumatic epilepsy attendant upon them, merit ultimate elevation.

A subdural hematoma occurring acutely, is as a rule associated with so much in the way of attendant brain damage such as contusion and laceration, that it of itself does not constitute the immediate threat to life. It is desirable, whenever feasible, to carry such a patient along conservatively for at least 24 hours, after which the clot should be evacuated. This practice is not always possible, since in many instances one cannot be certain that an extradural clot is not present. Under such circumstances diagnostic trephination is indicated and either variety of pachymeningeal bleeding, if found, is treated at the time.

Wherever possible surgery in head injuries should be carried out under local anesthesia. Inhalation anesthetics, such as ether, though inadvisable because of the tendency to increase cerebral congestion, may occasionally have to be used in restless patients. Under such circumstances an endotracheal tube is the preferred mode of administration. Where a procedure of short duration is anticipated, intravenous sodium pentothal can serve admirably.

4. *Supportive measures.*—These are indicated in all craniocerebral injuries, surgical and nonsurgical. Such measures are both of a general nonspecific nature and of a specific type in which efforts are directed toward the enhancement of cerebral function. Included among the former is the management of initial shock when present. Its treatment, as mentioned, does not differ from that of shock unassociated with head injury. Once a patient has emerged from shock and is known to have a nonsurgical lesion, his treatment need not depend to any great extent on the type of nonoperable trauma presumed to exist. Therapy in the different varieties follows certain general principles common to all. Routine measures applied to all cases alike, however, are ill advised. Scrupulous nursing with particular attention to the requirements of the stuporous patient, is of paramount importance. The maintenance of adequate nutrition by tube feeding, anticipation of decubitus, aspiration of nasopharyngeal secretions, and application of antipyretic measures if needed, are all indicated. Symptoms such as headache and restlessness are treated as they arise. In the former, the customary combination of caffeine, phenacetin and acetylsalicylic acid, will generally suffice. The judi-

cious use of chloral, bromides, and/or paraldehyde will generally control the disturbed patient.

More specific measures include those directed toward the reduction of intracranial hypertension if it is demonstrable. The degree of dehydration imposed should be governed by the extent of increased intracranial pressure. Lumbar puncture may be employed if it is apparent that the patient's headache is relieved by the reduction of pressure or the removal of subarachnoid blood. A too rapid or excessive reduction of intracranial tension is less well tolerated by the patient than a moderate increase of pressure which is maintained. One should guard against the possibility of carrying dehydration to the point of toxicity. Our own tendency has been to avoid drastic dehydration, reserving it for the very occasional nonoperable type of injury showing papilledema and/or an elevated cerebrospinal fluid pressure, bearing in mind that where such signs persist the chances are that the condition is apt to involve more than mere edema and congestion, being more likely on the basis of focal intracranial hemorrhage requiring evacuation.

Among the suitable measures to be used in all cases of brain injury, once the period of shock is past, not the least effective is the maintenance of the upright position. Not only does such a position favor an easier venous return from the brain and freer respiratory exchange, but it is also an effective means of lowering intracranial pressure in the event that it is desirable. Ordinarily, with the patient in the recumbent position, the cerebrospinal fluid pressure is the same in the cerebral ventricles and lumbar sac, but with the patient upright the intraventricular pressure diminishes by at least 400 mm. of water (7). The upright position, however, should not be used in dealing with deeply stuporous patients having evident accumulation of nasopharyngeal secretions, in view of the possibility of aspiration pneumonia.

The evidence at hand, as previously indicated, suggests that in many instances fatalities from brain injury are not attributable to intracranial hypertension alone. Accordingly, reduction of intracranial pressure is not the only specific therapeutic problem. Mention has been made of the important role of glucose in cerebral oxidation. Though the actual extent of cerebral hypoxia in brain injury has not been measured, there is evidence to indicate that edema, congestion, contusion and laceration of the brain may seriously impair its ability to oxidize glucose. The inherent therapeutic implications suggest the need for all measures which may maintain cerebral oxidation if irreversible damage is not to ensue. That oxygen administration is useful in brain injury has been demonstrated clinically (8). Glucose administration is of value, but it would appear that its beneficial effects are to be attributed more to direct influence upon

cerebral metabolism than to the dehydrative properties of the hypertonic solution.

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**FOUNDATION PRIZE OFFERED BY THE A. A. OF OBSTETRICIANS,
GYNECOLOGISTS, AND ABDOMINAL SURGEONS**

The award shall be known as the Foundation Prize and shall consist of \$150. Eligible contestants shall include only interns, residents, or graduate students in O. G. A. S., or physicians who are actively practicing or teaching obstetrics and gynecology.



GYNECOLOGISTS, AND ABDOMINAL SURGEONS

Wounds involving both the abdomen and the thorax have a grave prognosis. The missile may pass from the chest, with consequent damage to the structures in immediate relation to each side of the diaphragm. The severe degree of shock which is always present overshadows the relative symptoms and may mask the signs of abdominal hemorrhage. The position of entrance and exit wounds may lead the surgeon to suspect that both thoracic and abdominal organs have been injured; he must bear in mind always that the two wounds may have been caused by separate missiles. Bilateral lack of movement and rigidity of the abdomen with a chest wound or dyspnea or hemoptysis associated with an abdominal wound, are indicative of abdomino-thoracic injury.—Davies, H. M., and Coope, R.: *Abdomino-Thoracic Wounds.* War Injuries of the Chest. 98-100, 1942. The Williams and Wilkins Company, Baltimore, Maryland.

TEMPOROMANDIBULAR JOINT¹

LINZY L. WILLIS
Lieutenant (DC) U. S. N.

The subject of the temporomandibular joint is receiving more and more attention by both medical and dental officers. The service in general is also becoming well aware of its abnormal function, particularly those in the highly specialized field of aviation. The chief purpose of this paper is to try to clarify some of the underlying principles which must be thoroughly understood before rehabilitation of any character is undertaken.

Proper coordination and relationship of the special structures and forces of the head, mouth, and face produce normal function. These special structures and forces are divided by the median line into two distinct mechanisms; a right and left, each a coordinated unit in itself. Each unit is capable of individualized function but normally the two units coordinate to perform as one. Interrupted function in one unit affects the other by an unbalanced compensation effort, thereby altering the coordinated function of the forces and structures of both sides as a unit.

These structures naturally undergo slight changes over a period of years which are compensated for by nature, but remain in harmony to one another. This being true, the joints will remain normal in their anatomical respects and function. Abnormal articulation of the temporomandibular joint results from loss of harmony of the essential factors that govern normal balanced function of the right and left mechanisms. By the alteration of any one of these factors, a sudden attempted adaptation of the other is necessary to an abnormal degree in order to compensate for it.

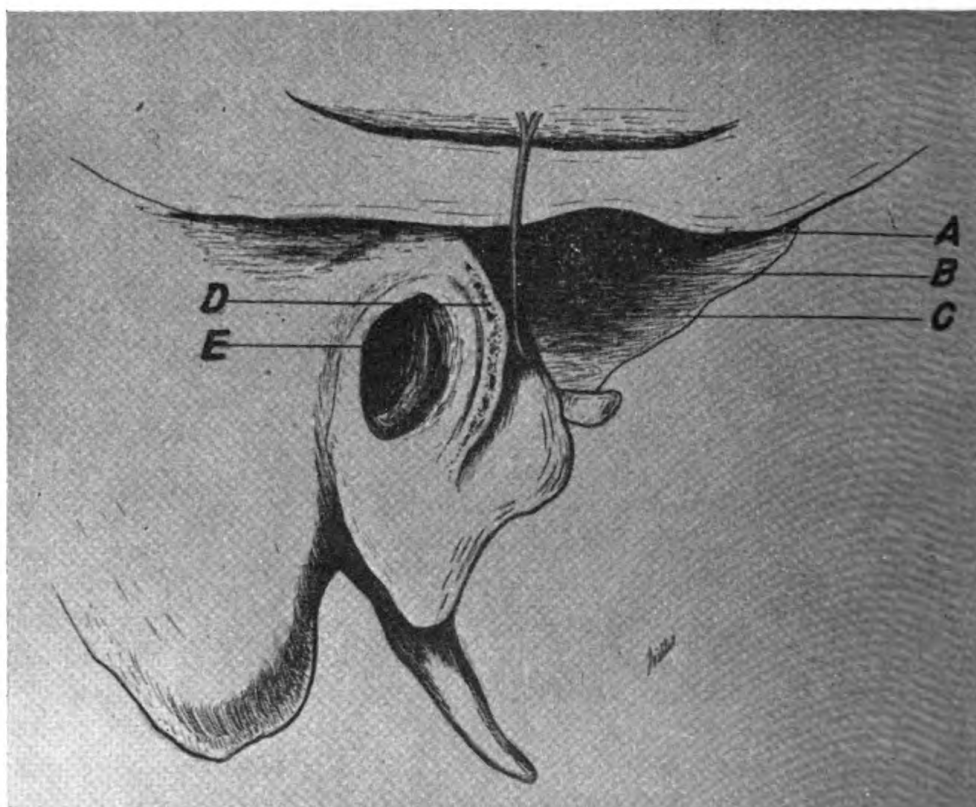
The criterion of normal joint function is therefore dependent upon normal balance. The structures which govern this balance are the mandibular fossa, condyle, meniscus, and joint cavities, muscles of mastication, ligaments, and the teeth. Usually an impairment of joint function or change of structure is due to alteration of muscular forces resulting from trauma and from missing posterior teeth, which are causes removed from the joint itself.

The mandibular fossa is located in the tympanic portion of the temporal bone and is inclined inward toward the front. Anteriorly it is bounded by the articular eminence of the zygomatic process. Posteriorly the postglenoid process descends behind the condyle and prevents it from being displaced backward. The lateral wall is a thin

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plate of bone presenting the petrotympanic fissure. The auriculo-temporal nerve emerges from this fissure and is often traumatized by the condyle in abnormal joint conditions (fig. 1).

The condyle or head of the mandible is a narrow ellipsoidal bar of bone directed medially and slightly backward, with a convex anterior surface. In normal temporomandibular articulation the anterosuperior surface of the condyle articulates with the inferoposterior surface of the articular eminence. Let us keep in mind then, that the normal articulation of the joint is in the anterior part of the fossa and never in the posterior or superior part. The teeth act as natural

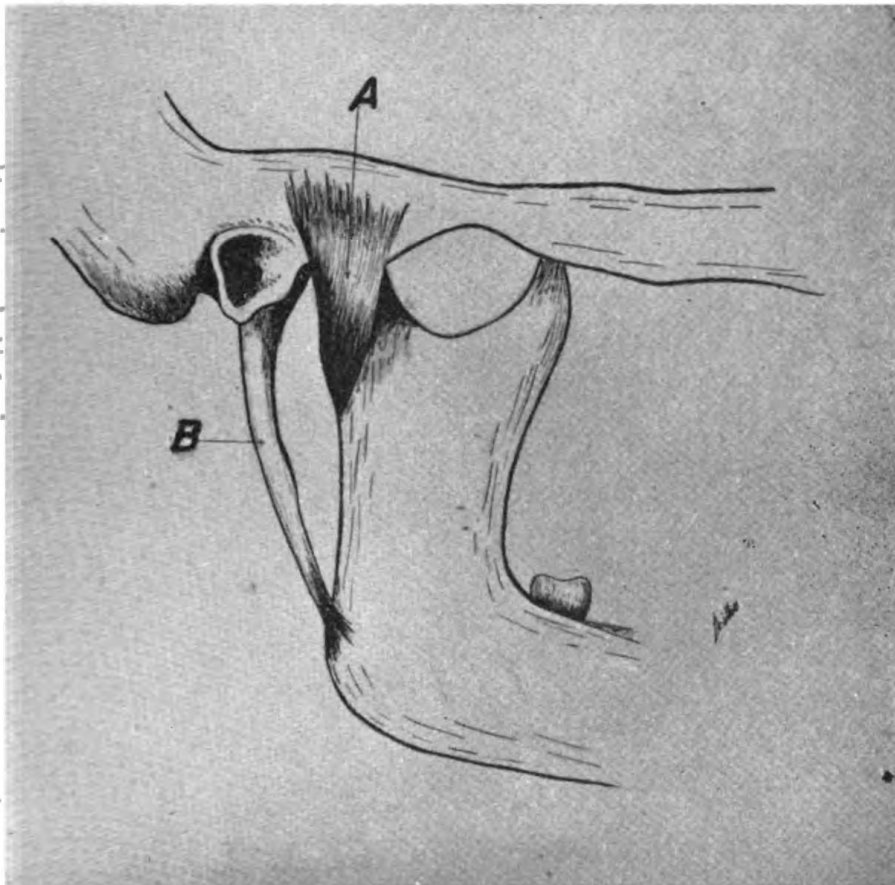


1. MANDIBULAR FOSSA. (A) ARTICULAR EMINENCE, (B) LATERAL PLATE. (C) AURICULOTEMPORAL NERVE. (D) TYMPANIC PLATE. (E) AUDITORY CANAL.

“stops” to prevent the condyle from being dislocated upward and backward. The loss of posterior teeth, the attrition of them or other deviations from normal may cause or permit such a dislocation.

The connecting structures of the synovial joint are the articular ligaments. The capsular ligament takes the form of a sleeve, each end of which is firmly attached in a continuous line around the articular surface and inferiorly to the neck of the mandible. The fibers of the ligament may form a dense felt-work; but during movement, where any recurring strain must be resisted, the fibers become arranged in parallel bundles in the line of straining force. Thus the temporomandibular ligament is formed (figs. 2 and 3).

Inside the joints, pads of fibrocartilage lie between the articular surfaces and blend peripherally with the capsular ligaments. Such fibrocartilage forms a complete articular disc attached to the capsule all round dividing the joint cavity into two separate compartments. These discs add their resilience to that of the articular cartilage in cushioning the bones. Two important factors to consider in maintaining the integrity of the proper union between the bones of the joint are the strength of the articular ligaments and tension of the muscles around the joint. It must be emphasized that white fibrous

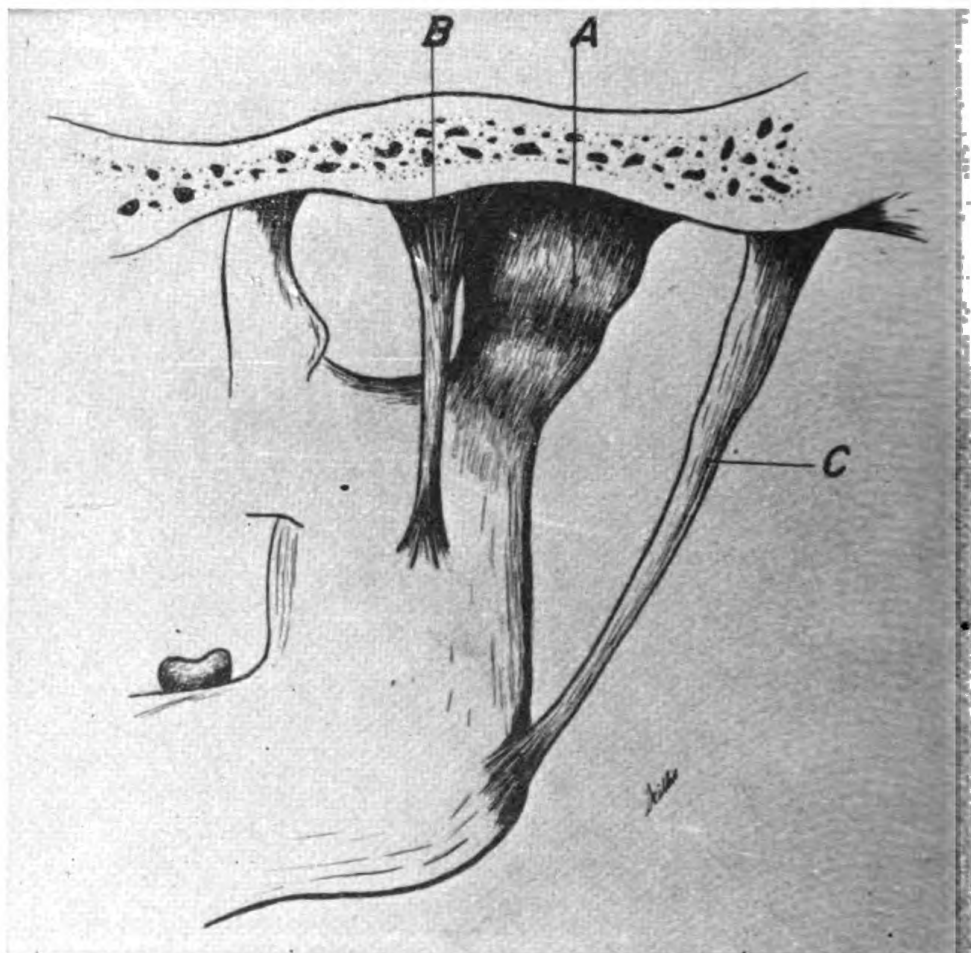


2. (A) TEMPOROMANDIBULAR LIGAMENT. (B) STYLOMANDIBULAR LIGAMENT.

tissue ligaments cannot resist continuous strains without lengthening permanently so that they must ever be supported by the contractile tension of muscle. Whether at rest or in contraction, the muscles around the joint are ever exerting by their active tonicity a force of joint approximation. Their efforts may be relieved considerably by suitable disposed ligaments, but no ligament will for long resist stretching under constant strain if unaided by muscular action.

The accessory ligaments in the vicinity are the sphenomandibular and the stylomandibular. The sphenomandibular ligament is a thin band that runs from the angular spine of the sphenoid bone and the

adjacent medial end of the petrotympanic fissure downward and forward to the lingula and adjoining part of the deep surface of the ramus of the mandible. The sphenomandibular ligament is separated from the temporomandibular ligament and the condyle by a space through which pass blood vessels and the auriculotemporal nerve. This nerve is important because it is one source of pain in abnormal joint conditions. The stylomandibular ligament is merely a thickening band of deep cervical fascia between the styloid process



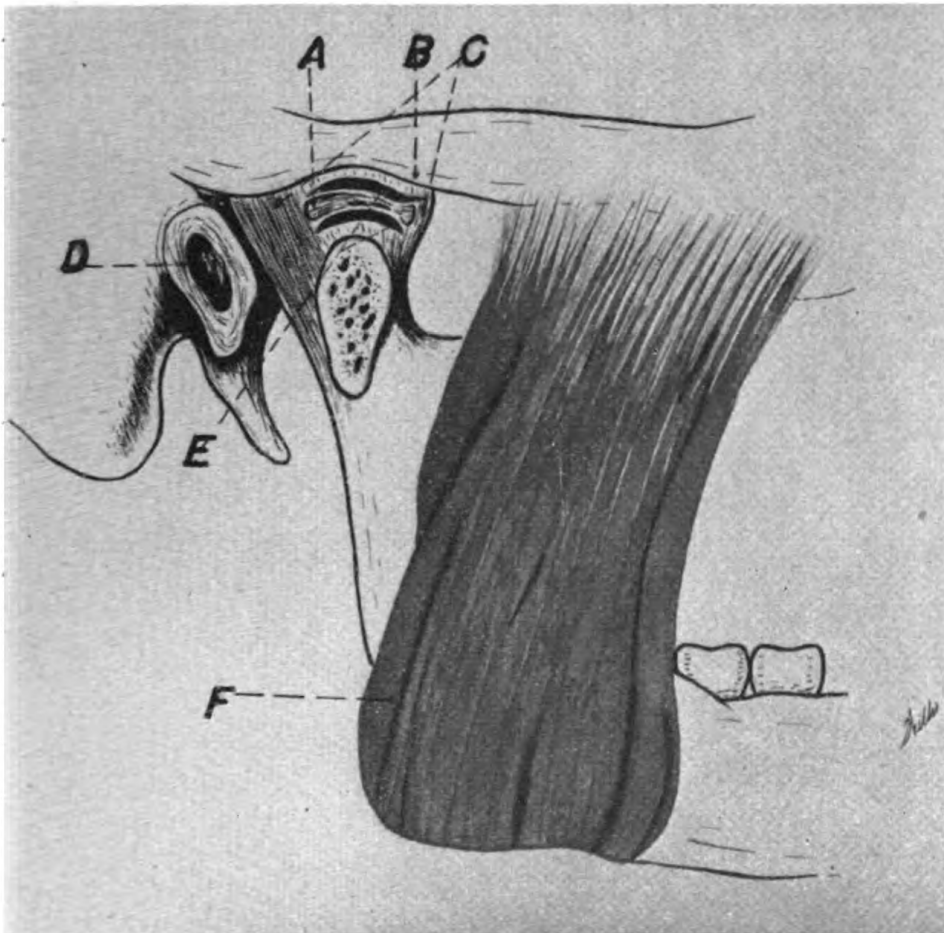
3. MEDICAL ASPECT. (A) CAPSULAR LIGAMENT. (B) SPHENOMANDIBULAR LIGAMENT. (C) STYLOMANDIBULAR LIGAMENT.

and lower part of the posterior border of the ramus of the mandible (fig. 3).

The muscles of mastication, combined with the ligaments, exert a normal central area of balance. By virtue of their origins and insertions, this area extends normally from the retromolar region anteriorly including the first molar. In the event of an altered or abnormal occlusal plane unilaterally, abnormal changes in the center of the balance is shifted to the right or left as the case may be. The

tonus of the muscle fibers is slackened on the affected side and in cases of closed vertical dimension both sides are slackened in over-closure of the jaw (figs. 4 and 6).

Normal mandibular movement is a well coordinated, synchronous movement confined to the normal limits by normal joint structures. It is a coordination of three distinct movements. The movements are:

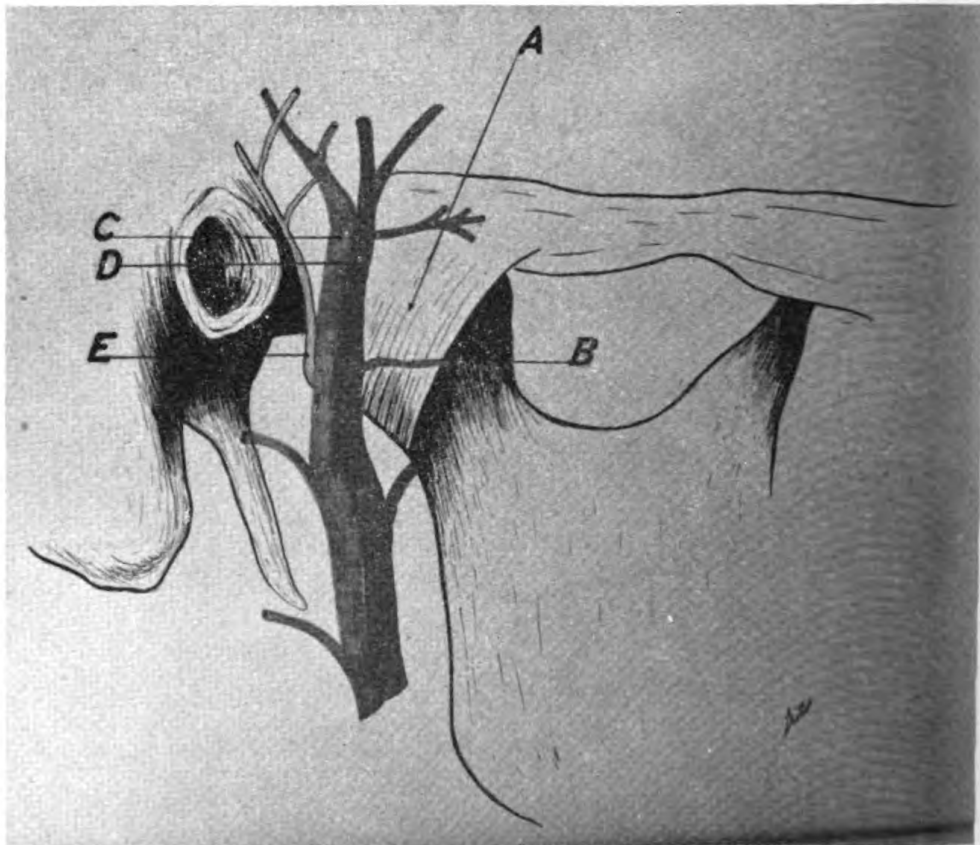


4. (A) MENISCUS. (B) ARTICULAR EMINENCE. (C) CAPSULAR LIGAMENT. (D) EXTERNAL AUDITORY CANAL. (E) JOINT CAVITIES. (F) MASSETER MUSCLE.

1. *The opening and closing movement.*—In this movement the condyle and disc of the upper compartment, acting as one, glide forward and downward round the posterior-inferior aspect of the articular eminence. In the lower compartment a hingelike rotation of the condyle under the concave surface of the disc takes place around a transverse axis. The upper part of the joint therefore acts like a plane joint, the lower part like a hinge joint, but the two components of movement are never completely dissociated. In this movement the two are equally involved; and of course the joints on both sides of the head act together.

2. *Lateral movement.*—This movement of the mandible is caused by its rotation on a central axis. It is brought about by alternate or opposite movements in the upper compartments of the two joints, combined with associated hinge movements in the lower compartments. The central axis is located within hypothetical normal central area of muscle balance. Normal lateral range is about one-eighth or one-quarter inch each side of the median line.

3. *Antero-posterior movement of protraction and retraction.*—Normal antero-posterior movement is mainly a gliding action following



5. RELATIONSHIP OF BLOOD VESSELS TO JOINT. (A) TEMPOROMANDIBULAR LIGAMENT. (B) TRANSVERSE FACIAL ARTERY. (C) SUPERFICIAL TEMPORAL ARTERY. (D) SUPERFICIAL TEMPORAL VEIN. (E) AURICULOTEMPORAL NERVE.

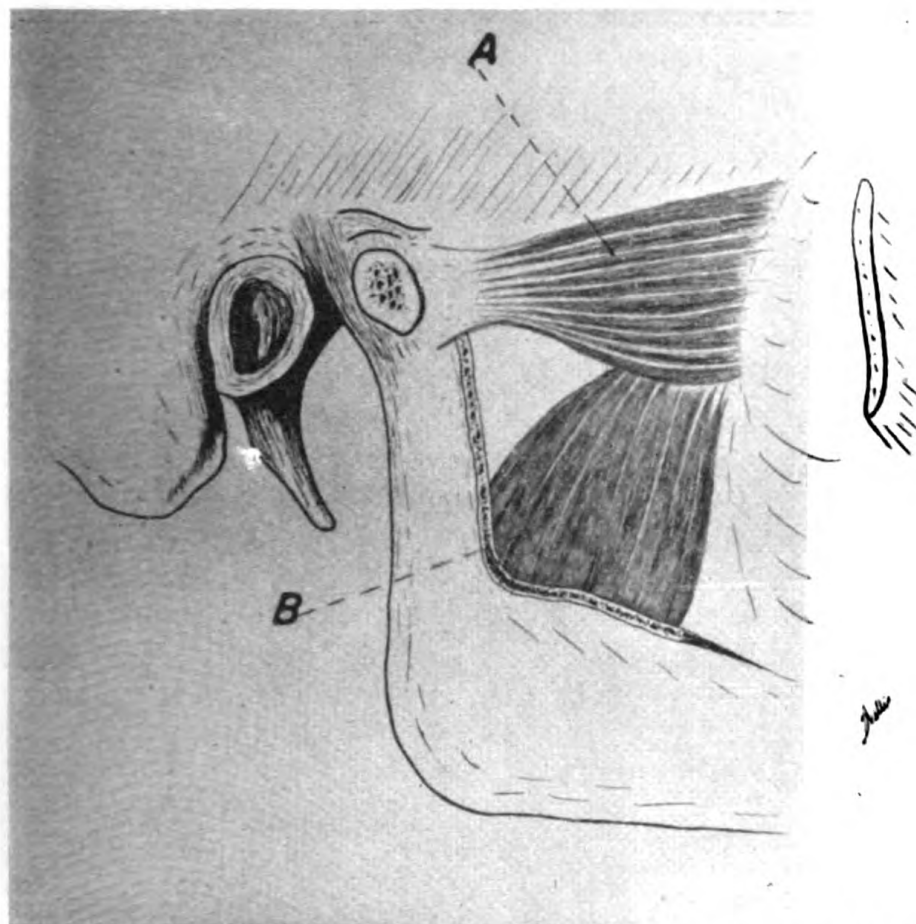
the normal condyle path and maintained by the teeth which follow the same path (fig. 4).

All three normal movements of the mandible in perfect coordination, governed by proper normal muscular balance tend to maintain the joints in normal articulation without any intra-articular wear on the structures. However, if any one of the movements is altered, it alters the others and the synchronous movement is inhibited, thereby altering normal movement and impairing joint structures.

Abnormal articulation of the joint may result in the following:

1. Wearing of the meniscus to complete disintegration, permitting the two joint cavities or compartments to become as one. In this condition the bone surfaces are allowed to rub against each other and crepitation is produced.

2. Erosion of the tympanic plate by the condyle snapping posteriorly and subluxation of the mandible. Perforation into the external auditory canal is probable.

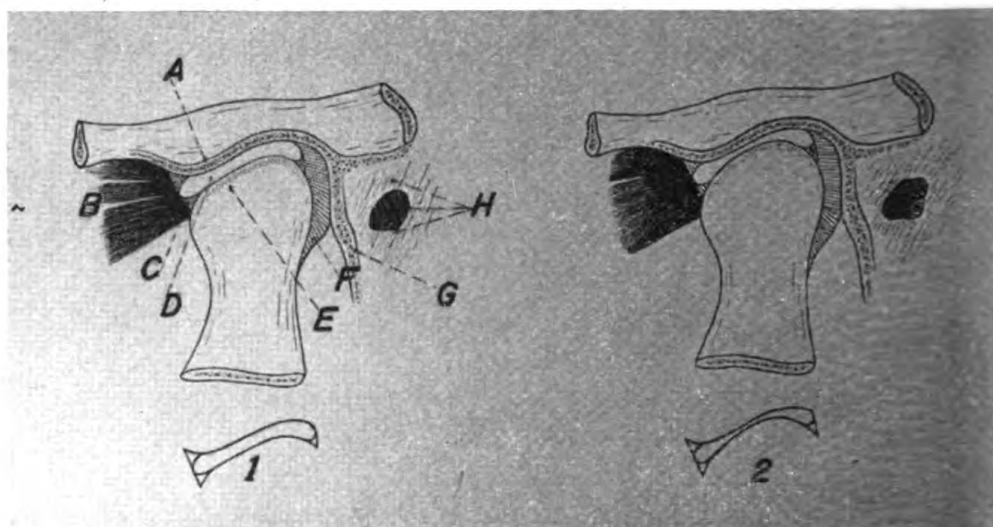


6. (A) EXTERNAL PTERYGOID MUSCLE. (B) INTERNAL PTERYGOID MUSCLE.

3. Steepening of the posterior surface of the articular eminence or flattening of the condyle by aseptic necrosis.

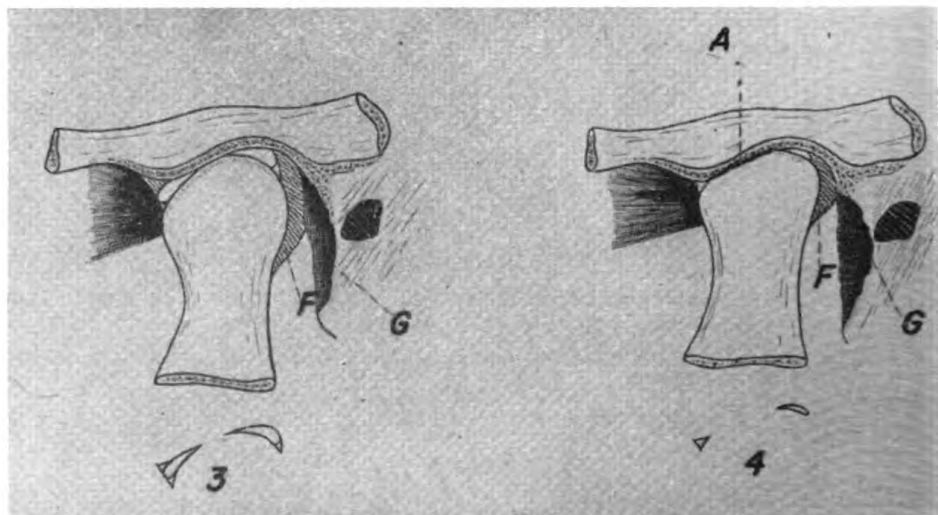
4. Deep erosion of the entire fossa producing an increase in the joint space. This produces a wrinkled and loose capsular ligament and stretching of the temporomandibular and sphenomandibular ligaments. Increased lateral movement is also noted (figs. 7 and 8).

It is imperative to harmonious joint function that proper dental occlusion be maintained. Malocclusion, attrition or interlocking of high cusps produce altered muscular balance and joint dysfunction. Improperly constructed dental restorations are also contribut-



7. JOINT DISINTEGRATION AS RESULT OF ABNORMAL ARTICULATION. (1) (A) ARTICULAR EMINENCE. (B) EXTERNAL PTERYGOID MUSCLE. (C) CAPSULAR LIGAMENT. (D) MENISCUS. (E) CORTICAL BONE OF CONDYLE. (F) CAPSULAR LIGAMENT. (G) TYMPANIC PLATE. (H) EXTERNAL AUDITORY CANAL. (2) SLIGHTLY WORN MENISCUS AS RESULT OF ABNORMAL CLOSURE OF TEMPOROMANDIBULAR JOINT.

ing factors. Erupting third molars, partially impacted and malpositioned are often responsible for altered occlusal balance. The advisability as to when or when not to remove these can only be decided by the dental officer after careful examination of the particular case. Cuspal interference can readily be detected by very light pressure exerted on carbon paper inserted on the occlusal surfaces



8. JOINT DISINTEGRATION AS RESULT OF ABNORMAL ARTICULATION. (3) MENISCUS PERFORATED. (F) CAPSULAR LIGAMENT LOOSE AND WRINKLED AS RESULT OF INCREASED JOINT SPACE AND LOSS OF VERTICAL DIMENSION. (G) EROSION OF TYMPANIC PLATE BY SNAPPING BACKWARD AND SUBLUXATION OF MANDIBLE. (4) (A) RECIPROCAL WEAR RESULTING IN FLATTENING AND ROUGHNESS OF ARTICULAR JOINT SURFACES. (F) RELAXED CAPSULAR LIGAMENT. (G) NEAR PENETRATION INTO EXTERNAL AUDITORY CANAL. MENISCUS DESTROYED PERMITTING THE TWO JOINT COMPARTMENTS TO BECOME ONE.

of the teeth. Premature contact of these members results in pain in the joint area but subsides shortly after extraction.

The symptoms arising from dislocation of the joint posteriorly, upward or laterally and the derangement of the ligaments and loss of muscular balance have been described by Costen,¹ as follows:

1. Pain, dull type, within and about the ears.
2. Tinnitus, usually "low buzz" in type, less often a snapping noise while chewing.
3. Stopping or "stuffy" sensation in ears.
4. Mild catarrhal deafness, which is improved by inflation of the eustachian tubes.
5. Dizzy spells, relieved by inflation of eustachian tubes.
6. Tenderness to palpation of temporomandibular joints.
7. Typical sinus headaches after sinus or eye involvement has been corrected, or typical headache when sinuses or eyes have been found to be negative; also pain in the top of head, behind the ear or at base of skull.
8. Traumatic, noisy, painful, limited or excessive movement of the temporomandibular articulation.
9. Neuralgia.
10. A burning or prickling sensation of the tongue, throat, and side of nose.
11. Eczema within external ear.
12. Metallic taste.
13. Excessive wax accumulation in the external canal.
14. Dryness of mouth due to disturbed function of salivary glands.

Some causes of these symptoms have been previously mentioned but further anatomical study of the mandible and temporomandibular joint shows why these symptoms arise when abnormal joint position is manifest.

Pressure of the condyle may close the external auditory canal, as about 25 mm. of this canal is cartilaginous, 10 mm. osseous.

The chorda tympani nerve passes between the bones of the middle ear and emerges through the petrotympanic fissure into the glenoid fossa. This nerve supplies the submaxillary ganglion. It is interesting to note how abnormal conditions of the mandible may give rise to pain in the ear and temple. The afferent impulse travels along the inferior dental or lingual to the chorda tympani and facial nerves. The facial and auditory nerves traverse the internal auditory meatus and are united by the intermedius. Thus the afferent impulse reaching the facial nerve is transmitted to the auditory, creating pain in the ear. Pain in the temple is carried by the inferior dental and auriculotemporal nerves. Trauma from the condyle on the nerve as it emerges from the petrotympanic fissure is accountable for disturbances in the middle ear whether they be transmitted by the sensory fibers or reflex.

¹ Costen, J. B.: Syndrome of ear and sinus symptoms dependent upon disturbed function of the temporomandibular joint. *Ann. Otol., Rhin. & Laryng.* 43: 1-5, March 1934.

The auriculotemporal nerve also emerges from the petrotympanic fissure and distributes over the temporal region and the base of the skull.

RELATIONSHIP OF THE EUSTACHIAN TUBES TO OVERCLOSURE OF THE
MANDIBLE

At sea level the atmospheric pressure is about 15 pounds per square inch and at 17,000 feet this pressure drops to 7 pounds. As greater altitudes are reached, the pressure is diminished proportionally. As the pilot ascends his body functions must be adjusted to the decreased pressure. Upon rapid descent, pressure of 6 pounds or more is developed in 1 minute. Air will leave the eustachian tubes more easily than it will enter them, so unless they are functioning perfectly complications can be expected.

Two muscles are primarily responsible for the eustachian tube function—the levator veli palatini and tensor veli palatini. The levator veli palatini is a rounded muscle with a double origin; first, from the quadratus area of the lower surface of the petrous portion of the temporal bone, and second, from the inferior part of the cartilaginous part of the auditory tube. It passes downward and medially and is inserted into the aponeurosis of the soft palate. It is separated from the tensor veli palatini by the auditory tube.

The tensor veli palatini is a flat, triangular muscle which arises from the scaphoid fossa and angular spine of the sphenoid and from the lateral side of the cartilaginous part of the auditory tube. It descends between the internal pterygoid muscle and medial pterygoid lamina and is inserted into the posterior border of the hard palate and into the aponeurosis of the soft palate.

The auditory tube is opened by the contraction of the tensor veli palatini muscle and closed during swallowing by the compression of its wall by the contraction of the levator veli palatini. In overclosure of the mandible, the pterygoid muscles and sphenomandibular ligament and adjacent tissues are relaxed and slackened. This produces a pressure on the pharyngeal end of the eustachian tube rendering the tensor veli palatini powerless to dilate it. Deafness of variable degree and vertigo may result. Dizziness is of most importance in aviation as it may be of mild or prostrating severity.

In our physical examination given to those men who aspire to the rapidly expanding air corps, meticulous care is given to the dental aspects of the examination with regards to the intermaxillary dimension. Cases presenting normal bites and those of "mild" overclosure are readily accepted. Those who have marked degrees of closed bites are very apt to develop one or more of the characteristic symptoms during or after flight training and have to be grounded. Governmental expenditure of time and money is appreciable in training these men.

Rehabilitation of this particular type of temporomandibular joint abnormality can be successfully performed by constructing cast, removable occusal splints which permit normal physiological function of the anatomical structures involved.



**THE SIR HENRY WELLCOME MEDAL AND PRIZE
COMPETITION FOR 1943**

The competition is open to all medical department officers, former such officers, acting assistant and contract surgeons of the Army, Navy, Public Health Service, Organized Militia, Veterans' Administration, U. S. Volunteers, and the Reserves of the United States, commissioned officers of foreign military services, and all members of the Association, except that no person shall be eligible for a second award of this medal and prize. It should be understood that no paper previously published will be accepted.

The award of 1943, a gold medal and a cash prize of \$500 will be given for the paper selected by a committee of the Association's vice presidents which best covers the topic selected for the competition of this year. The title chosen is:

**BURNS INCIDENT TO WAR. MEASURES FOR THEIR
PREVENTION AND FOR TREATMENT**

The intent in formulating this title is to allow the widest scope for discussion of the subject. Under the head of preventive measures it will be possible to discuss any one or more of the several phases of the topic, such as burn prevention in aviation, on ship board, in mechanized warfare, in hazardous war industries, and in air raids upon civilian populations. Under preventive measures should be included such items as organizational arrangements, safety precautions, and safety devices. Under treatment cover only the first 24-hour care of the burn and immediate complications.

Each competitor must furnish five copies of his competitive paper. Papers must not be signed with the true name of the writer, but are to be identified by a nom de plume or distinctive device. They must be forwarded to the Secretary of the Association of Military Surgeons of the United States, Army Medical Museum, Washington, D. C., so as to arrive at a date not later than August 31, 1943, and must be accompanied by a sealed envelope marked on the outside with the fictitious name or device assumed by the writer and enclosing his true name, title, and address. The length of the essays is fixed between a maximum of 10,000 words and a minimum of 3,000 words. The envelope accompanying the winning essay or report will be opened by the president of the association and the name of the successful contestant announced by him. The winning essay or report becomes the property of the association, and will be published in *The Military Surgeon*. Should the Board of Award see fit to designate any paper for "first honorable mention" the Executive Council may award the writer life membership in the Association of Military Surgeons, and his essay will also become the property of the association.

THE INACTIVATION BY HUMAN SKIN OF INFLUENZA VIRUS IN THE PRESENCE OF SALIVA¹

THE PERSONNEL²

of

Naval Laboratory Research Unit No. 1, U. S. N. R.
University of California
Berkeley, Calif.

It has recently been demonstrated (1) that influenza viruses are highly susceptible to the effects of desiccation on human skin. The viruses used for impregnation of the various surfaces tested were suspended in a broth medium and within 10 minutes after drying on the palms of hands, both types of influenza viruses, PR-8 and Lee, were completely inactivated as shown by the absence of lesions in intranasally inoculated mice. That this complete inactivation of the virus was not due to the drying alone, nor to the temperature of the skin surface, was shown by the recovery of active virus from similar inocula dried on glass surfaces at room temperature and on cellophane or rubber sheeting at palm temperature.

Under actual conditions of transfer of influenza virus by man the infective agent would most likely be suspended in salivary secretions, either in the form of an expectorated mass or droplets of saliva ejected during coughing, sneezing, talking, laughing, etc. In view of this fact it was deemed advisable to investigate the possible effect of a saliva milieu on the virus-inactivating power of the skin.

Normal human saliva is known to possess definite bactericidal powers against certain organisms (2) (3) (4) (5). Its pH varies somewhat according to the individual, the diet, the time of day, and pathological conditions. Approximately 0.5 percent of saliva is organic matter, of which about 0.4 percent is protein, chiefly mucin, with small amounts of albumin and globulin. Present also are salivary amylase (ptyalin), urea, uric acid, cholesterol, and phospholipid.

¹ Received for publication December 19, 1942.

² The Unit Personnel consists of: Commander A. P. Krueger, Medical Corps, Officer-in-Charge; Lieutenant L. E. Rosenberg, H-V (S); Lieutenant N. S. West, H-V (S), all of the United States Naval Reserve; Lieutenant J. W. Hope, Medical Corps, United States Navy; and Lieutenant, junior grade, A. H. Jacobs, Medical Corps; Lieutenant, A. S. Browne, H-V (S); Lieutenant O. J. Golub, H-V (S); Lieutenant, junior grade, J. R. Mathews, H-V (S); Ensign H. M. S. Watkins, H-V (S); Ensign M. D. Thaxter, Hospital Corps; Ensign A. J. Glazko, H-V (S); Ensign G. B. Saviers, Hospital Corps; Pharmacist I. L. Schechmeister; Pharmacist's Mate, first class, W. L. Axelrod; Pharmacist's Mate, first class, E. R. Chisholm; Pharmacist's Mate, second class, C. R. Webb, Jr., Pharmacist's Mate, second class, H. R. Burkhead, all of the United States Naval Reserve; Pharmacist's Mate, first class, P. J. Smith, United States Navy; Pharmacist's Mate, third class, J. A. Gray, United States Naval Reserve; and Hospital Apprentice, first class, D. D. Mentz, United States Navy.

The results of the present experiment indicate that saliva does not interfere with the virus-inactivating power of the palmar skin.

VIRUS

The virus employed was from a stock supply of PR-8 mouse lung passage No. 372, in a concentration of 10 percent by weight in broth. By previous titration of infectivity in mice the 50 percent mortality end point was found to be 5.7×10^{-8} , i. e., 0.05 cc. of a dilution of 5.7×10^{-8} in broth inoculated intranasally into lightly anesthetized mice will kill 50 percent of the animals within 10 days.

EXPERIMENTAL PROCEDURE

Following the procedure of the previous experiments, the subject's hands were washed thoroughly with soap and water and held under sterile towels until dry. Four-tenths cc. of a virus-saliva suspension was then smeared over an area of 9 square inches on each palmar surface. The virus-saliva mixture consisted of a 10 percent PR-8 mouse lung virus diluted 1:10 in pooled human saliva from five normal individuals; thus, the concentration of virus inoculated was 1 percent. In order to control the effect of temperature, 0.4 cc. of the virus-saliva mixture was also smeared on similar areas of clean, thin rubber sheeting attached to the palms, and on the surface of two sterile Petri dishes. The time required for the smears to dry was noted and subsequent periods of exposure in the desiccated state were measured accordingly.

Ten minutes after the smears were dry the impregnated areas of one palm, one rubber sheet surface, and one Petri dish were covered with 0.8 cc. of sterile broth. The surfaces were rubbed thoroughly to recover the maximum amount of the desiccated film and the suspensions obtained in this manner were immediately tested for residual active virus by inoculation of 0.05 cc. intranasally into mice. Each suspension was further diluted out 1:10 and 1:100 in broth and inoculated into mice for better quantitative comparison. Assuming that all the material inoculated upon each surface was active and recoverable, the virus concentrations in the suspensions inoculated into the mice were 0.5, 0.05, and 0.005 percent respectively. Forty minutes after drying, this procedure was repeated using the smeared surface of the other palm, the other rubber sheet, and the second Petri dish.

Controls were included on the effect of saliva on the virus in the undried state. The 10 percent mouse lung suspension was diluted 1:10 in the pooled saliva and a sample diluted also 1:10 in sterile broth. These suspensions were held in test tubes at room temperature for the duration of the experiment, at the end of which time each mixture was diluted out in broth to final virus concentrations of 0.5, 0.05,

0.005, and 0.0005 percent. Each dilution was then inoculated intranasally into mice.

The effect of saliva alone was controlled by intranasal inoculation of mice with undiluted saliva and saliva diluted 1:10 in broth.

The mice were observed for a period of 10 days and records kept as to the dates of death of all mice succumbing to infection. Survivors were autopsied on the tenth day following inoculation and the lungs of each animal scored according to the extent of pulmonary consolidation.

Table 1 summarizes the results of this experiment. It can be seen that within 10 minutes after drying on the palmar surface no residual active virus was recoverable, as evidenced by the absence of lesions in mice inoculated. Two out of 6 mice receiving the most concentrated (0.5 percent) material from the 40-minute dried sample showed small lesions of questionable significance. The rapidity and extent of this destruction of the virus suspended in saliva reproduces the results obtained in the experiments previously reported (1), in which broth was employed as the suspending medium.

Considerable virus infectivity remained in the material recovered from the rubber sheeting and the Petri dish surfaces in both the 10-minute and 40-minute samples. There was definitely a greater recovery of virus from the glass surface at room temperature than from the rubber sheeting at skin temperature, indicating the partial, but slight, role of the higher temperature on the inactivation of influenza virus by the skin. The results also show that in both the rubber-dried and glass-dried preparations there was a significant decrease in activity of the samples recovered at the 40-minute interval as compared with the 10-minute period.

TABLE 1.—*The influence of saliva on capacity of the palmar skin to inactivate type A influenza virus dried on its surface*

Virus treatment	Time dried	Virus concentration inocula	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	Lesion score
	<i>Min.</i>	<i>Percent</i>							
Skin dried.....	10	.5	K ₀	K ₀	K ₀	K ₀	K ₀	K ₀	0/30
Do.....	10	.05	K ₀	K ₀	K ₀	K ₀	K ₀	K ₀	0/30
Do.....	10	.005	K ₀	K ₀	K ₀	K ₀	K ₀	K ₀	0/30
Do.....	40	.5	K ₁	K ₁	K ₀	K ₀	K ₀	K ₀	2/30
Do.....	40	.05	K ₀	K ₀	K ₀	K ₀	K ₀	K ₀	0/30
Do.....	40	.005	K ₀	K ₀	K ₀	K ₀	K ₀	K ₀	0/30
Rubber dried.....	10	.5	5	8	8	8	8	8	30/30
Do.....	10	.05	10	K ₄	K ₄	K ₂	K ₂	K ₂	20/30
Do.....	10	.005	K ₂	K ₂	K ₁	K ₁	K ₀	K ₀	6/30
Do.....	40	.5	7	9	K ₃	K ₃	K ₂	K ₂	20/30
Do.....	40	.05	K ₄	K ₂	K ₁	K ₁	K ₁	K ₁	10/30
Do.....	40	.005	K ₁	K ₀	K ₀	K ₀	K ₀	K ₀	1/30
Petri dried.....	10	.5	4	6	6	7	7	7	30/30
Do.....	10	.05	7	8	9	10	K ₄	K ₂	26/30
Do.....	10	.005	K ₄	K ₄	K ₄	K ₃	K ₂	K ₂	19/30
Do.....	40	.5	5	6	6	7	8	8	30/30
Do.....	40	.05	K ₄	K ₄	K ₃	K ₃	K ₃	K ₃	20/30
Do.....	40	.005	K ₂	K ₁	K ₁	K ₀	K ₀	K ₀	4/30

TABLE 1.—*The influence of saliva on capacity of the palmar skin to inactivate type A influenza virus dried on its surface—Continued*

Virus treatment	Time dried	Virus concentration inocula	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	Lesion score
	Min.	Percent							
Virus control in saliva.....		.5	4	5	5	6	7		25/25
Do.....		.05	5	6	6	7			20/20
Do.....		.005	5	6	6	K ₂			17/20
Do.....		.0005	7	7	8	9	9		25/25
Virus control in broth.....		.5	4	4	5	7	7		25/25
Do.....		.05	4	6	7	7			20/20
Do.....		.005	6	7	8	8	9		25/25
Do.....		.0005	5	7	8	8			20/20
Saliva control.....		Undil.	K ₀	K ₀	K ₀	K ₀	K ₀	K ₀	0/30
Do.....		1:10	K _±	K _±	K ₀	K ₀	K ₀	K ₀	11/30

Protocol of mouse inoculation results recorded as follows:

K=killed after 10 days observation.

Subscript of K=number of consolidated lobes noted.

Plain numerals=day of death with all 5 lobes consolidated.

Lesion score:

Numerator=total consolidated lobes observed.

Denominator=total possible consolidated lobes.

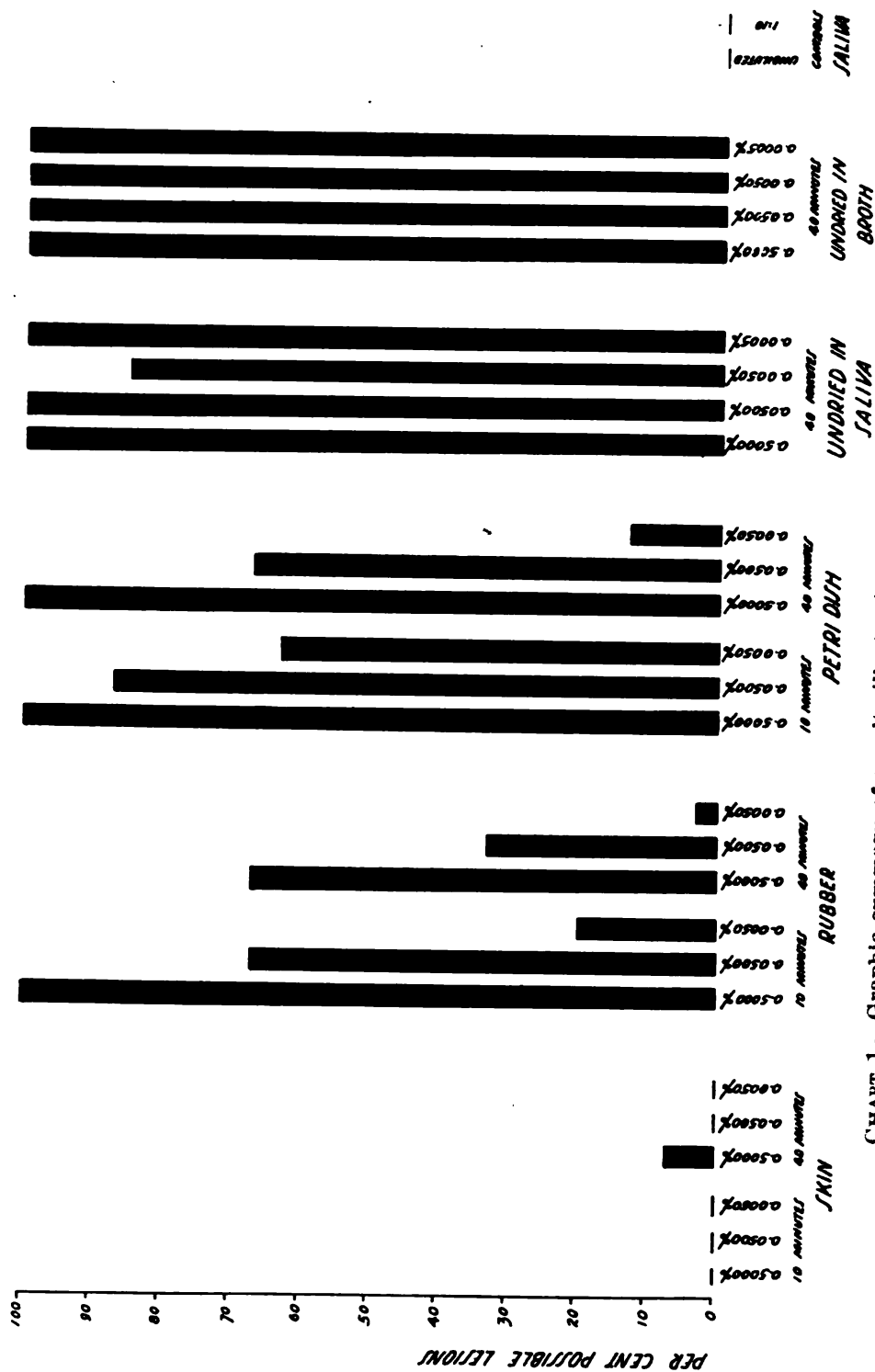
That the saliva itself had no appreciable effect upon the virus is shown by the titrations of the undried virus suspended in saliva and in broth. Although the most dilute suspensions in each case produced 100 percent mortality, the consistency in their comparative death dates is good evidence that the virus activity of the two samples was approximately the same. From a comparison of the titration of the undried virus-saliva suspension with the Petri-dried sample it is evident that desiccation alone for 10 minutes at room temperature results in considerable inactivation of the virus, although comparing only feebly to the rapid action of desiccation on the skin surface.

The control mice inoculated with saliva alone showed no lesions which would possibly confuse the results.

Chart 1 is a graphic presentation which gives a clearer comparative picture of the experimental findings. Considering a lesion of 5 as death within 10 days and thus the maximum lesion score per mouse, the cumulative lesions observed in each group of mice is plotted on the ordinate as percent of possible lesions.

DISCUSSION

The results of this experiment merely serve to strengthen the conclusion that manual transmission of dried influenza virus is not an important health hazard. On the other hand, however, confirmation of the ability of the virus to withstand desiccation on inert surfaces even in the presence of saliva should serve to stress the value of precautionary measures in the handling of fomites of influenza infected patients.



SUMMARY

Influenza virus in the presence of saliva was rapidly destroyed when dried on the palmar skin. Within 10 minutes time the virus had lost infectivity for mice by intranasal inoculation.

The virus was similarly tested for its resistance to desiccation on rubber sheeting at skin temperature and on a glass surface at room temperature. The rate of inactivation of the virus at the skin temperature was noticeably higher than at room temperature. Both surfaces tested, however, still showed residual active virus after 40 minutes in the dried state.

The action of saliva on virus in the undried state was tested by comparison of mouse infectivity with virus suspended in broth. No inactivating effect of saliva was observed.

Intranasal inoculation of saliva alone caused no injurious effects in mice.

CONCLUSIONS

1. The presence of saliva does not inhibit the previously demonstrated capacity of the skin to inactivate influenza virus dried upon its surface.
2. Virus dried in saliva on rubber sheeting and on glass surfaces retains considerable activity as long as 40 minutes after drying.
3. Saliva itself has no virucidal action on PR-8 influenza virus.

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REACTIVITY OF THE SKIN¹

EFFECT OF ANESTHESIA AND SHOCK ON THE HISTAMINE AND ALLERGIC RESPONSES

GEORGE C. HENNIG

Lieutenant (MC) U. S. N. R.

Human plasma and albumin are now being prepared in large amounts for the treatment of shock and burns by the military forces. However, there is great need for still larger amounts of some blood substitute of other than human origin which can be made readily available. For this purpose it has been proposed to substitute bovine albumin as a more abundant and more available source for meeting these needs.

The question of the antigenicity of these foreign proteins naturally raises a practical problem. The importance of this question becomes even greater when it is realized that many patients will need repeated large amounts of these foreign proteins. It has been maintained that anesthesia protects against anaphylaxis, and it is possible that patients in severe shock do not react as strongly to reinjection of antigenic substances as do normals.

It was the purpose of this study to ascertain with greater certainty whether patients under anesthesia or in shock who might be subjects for treatment with a protein blood substitute show any diminution in their reactivity as measured by their skin reaction to histamine or to natural allergens.

REVIEW OF THE LITERATURE

There are reports in the literature concerning the effects of anesthesia on histamine shock and anaphylaxis. Besredka and later Farmer (1) showed that the antibody-antigen reaction takes place under anesthesia, but believed that the typical anaphylactic reaction was suppressed. Farmer found that the presence of urethane inhibited anaphylactic contraction of guinea-pig uterine muscle, but that desensitization had taken place under the anesthesia, suggesting that the antibody-antigen reaction had occurred. Katz (2) sensitized guinea pigs to egg albumin and then exposed the uteri and lungs to the sensitizing antigen while they were under ether or urethane anesthesia. He found that the normal release of histamine which occurred in the control group did not take place in the group under anesthesia. Since it is known that the antibody-antigen reaction does occur under these circumstances, the author felt that the suppression of anaphylactic response was due to the suppression of histamine release. Re (3) found

¹ Received for publication October 19, 1942.

that ether afforded guinea pigs some degree of protection against anaphylactic shock when employed either during the sensitizing or the shocking procedure. Koontz and Shackelford (4) also found that they could protect some of their guinea pigs from anaphylaxis by anesthesia. Dale (5) in 1920, however, had studied histamine shock in cats and felt that in his short series, ether anesthesia made the animal more sensitive to histamine shock. Dragstedt (6) failed to find any ameliorating effect of anesthesia on anaphylaxis in dogs.

Experience with human anaphylaxis under anesthesia has not been extensive. It is said that anaphylactic shock occurs during operations on echinococcus cysts less frequently when ether is used rather than a local anesthetic (10). Quill (7), on the other hand, does not believe that anesthesia offers effective protection against anaphylaxis. He found that he could produce anaphylactic shock in guinea pigs, dogs, and rabbits during anesthesia. He also presents a case in which he believes that death due to anaphylactic shock in a human subject resulted from antitetanus serum administered during ether anesthesia.

From this brief survey of the literature it is apparent that there is no general agreement on the effect of anesthesia on anaphylaxis, but the fact that some observers were able to offer protection to a certain percentage of their animals supports the view that there is less danger of severe anaphylaxis under ether anesthesia.

It is generally agreed that there is some relationship between histamine shock and anaphylaxis. It is also fairly well founded that natural allergies manifest themselves in a manner similar to local histamine reactions. According to Dale (8), the antibody-antigen reaction releases a histamine-like substance which is probably responsible for some of the symptoms of anaphylaxis. It is true that histamine can cause many of the symptoms found in anaphylaxis, but anaphylactic shock does differ in some features from pure histamine shock, and it has not been proved as yet that anaphylaxis causes tissue injury by the action of histamine alone. It may be that the differences are purely quantitative, or that there is some other chemical which is also released, or possibly that some of the pathological changes in anaphylaxis are secondary to the primary tissue injury. Then again it may be that histamine released from the cell has a different action from that applied to the outer surface of the cell, or that histamine plays only a secondary part in anaphylaxis. Feldberg (9) reviews the literature on the subject and one can only conclude that, at the present time, the evidence for the close relation between histamine shock and anaphylaxis is suggestive but not conclusive.

METHODS

A histamine stock solution, supplied in 1 cc. ampules in a 1:1000 dilution, was employed. This stock solution was diluted with

physiological saline into three dilutions which were used for our series of tests. These dilutions were: 1:100,000, 1:1,000,000, and 1:10,000,000. Intradermal injections of 0.1 cc. of these particular dilutions gave skin flares which seemed to us to reach the smallest and largest size which could be measured with any degree of accuracy. Flares were measured 10 minutes after the injection. Each day fresh solutions were made and tested on a control case tested the previous day. For testing natural sensitivity, solutions of common allergens were supplied by the Vanderbilt Clinic allergy department. Dust, ragweed, timothy, peanut oil, codfish, and horse-dander solutions were used to test for natural sensitivity preoperatively.

The intradermal injection of 0.1 cc. of the serial dilutions of histamine was used exclusively for the histamine skin tests. The amount of allergen solution used was 0.03 cc. Injections were made through a size-27 hypodermic needle, using a 1 cc. tuberculin syringe.

The site of injection was the inner aspect of the forearm, and in those cases where the leg was also used, the anteromedial aspect of the thigh was chosen. Although there was very little difference in the size of the flares regardless of which part of the forearm or thigh was chosen for any specific dilution, wherever possible the highest dilutions were injected near the wrist and knee, and the lowest dilutions near the antecubital fossa and groin. This system was adhered to except in a few cases where the type of operation made this impossible.

TABLE 1.—Averages of size of histamine skin flare in control groups

Histamine concentration	Control group, first test (25)	Control group, second test (25)	Controls before spinal anesthesia (22)	Controls before general anesthesia (84)	Controls before pentothal anesthesia (10)
	<i>Mm. flare</i>	<i>Mm. flare</i>	<i>Mm. flare</i>	<i>Mm. flare</i>	<i>Mm. flare</i>
1:100,000.....	44.4	42.3	42.4	43.3	41.6
1:1,000,000.....	27.3	28.1	25.6	27.7	25.4
1:10,000,000.....	10.7	11	12.1	14.8	13.7

Numbers in parentheses represent number of cases.

Measuring the size of the skin flares proved to be the most difficult part of the experimental procedure. With the dilutions used, the wheal did not enlarge to any great extent in most of the cases, nor did pseudopods form. For this reason the flare was measured rather than the wheal. The figures reported in this paper represent in each case the largest diameter of the flare, which ordinarily assumed a roughly round or oval shape.

RESULTS

Control group.—The size of the histamine flare was remarkably constant from day to day in the same patient. Tests were done from 1

to 4 days apart so as to simulate as nearly as possible the time interval between the control test and the test done during operation under anesthesia in the other groups. As seen in the first two columns in table 1 and in figure 1 the averages of the two sets of tests are very close. It is also of interest that the averages in the control tests done in the other groups are also very similar.

Ether and gas-oxygen anesthesia.—In practically every case in which there was moderately deep anesthesia of a duration over 30 minutes there was found to be a measurable diminution in the size of the histamine flare. In all, 84 cases were studied in this group. The majority

COMPARISON OF SIZE OF HISTAMINE FLARE IN CONTROL GROUP ON DIFFERENT DAYS

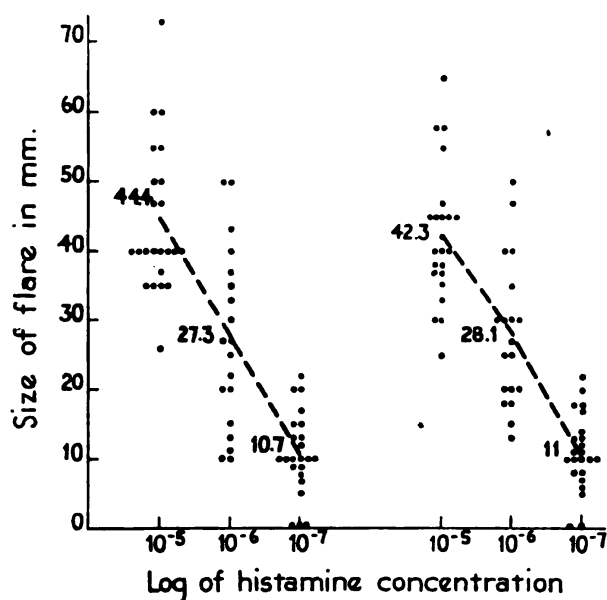


FIGURE 1.

of cases had ether alone or ether following the basal narcotic, avertin. Eleven cases had avertin followed by nitrous oxide and oxygen anesthesia. One case had nitrous oxide and oxygen only. As seen in table 2 and figure 2 there was a significant diminution in the histamine reaction in both the ether and the nitrous oxide groups. In general, it was found that the greatest diminution in the size of the flare occurred in those cases which were subjected to the longest and deepest anesthesia. The length of time necessary for the histamine flare to return to normal also seemed to depend on the depth and duration of the anesthesia. The patients in whom the anesthesia was of short duration showed less decrease in the size of the skin flare and a shorter recovery time after cessation of anesthesia than those patients subjected to longer anesthesia.

TABLE 2.—Averages of histamine flare size under ether and gas-oxygen anesthesia

Histamine concentration	Control before anesthesia (84)	During ether anesthesia (64)	During gas oxygen anesthesia (9)	During anesthesia and shock (11)
1:100,000.....	<i>Mm. flare</i> 43.3	<i>Mm. flare</i> 27.1	<i>Mm. flare</i> 23	<i>Mm. flare</i> 18
1:1,000,000.....	27.7	15.3	12.8	9
1:10,000,000.....	14.8	6.6	5.9	6

Numbers in parentheses represent number of cases.

When general anesthesia was accompanied by shock, the decrease in the size of the flare was found to be greater than in those patients not showing signs of shock. The greatest decreases and the lowest values were found in the cases in which general anesthesia and shock were combined.

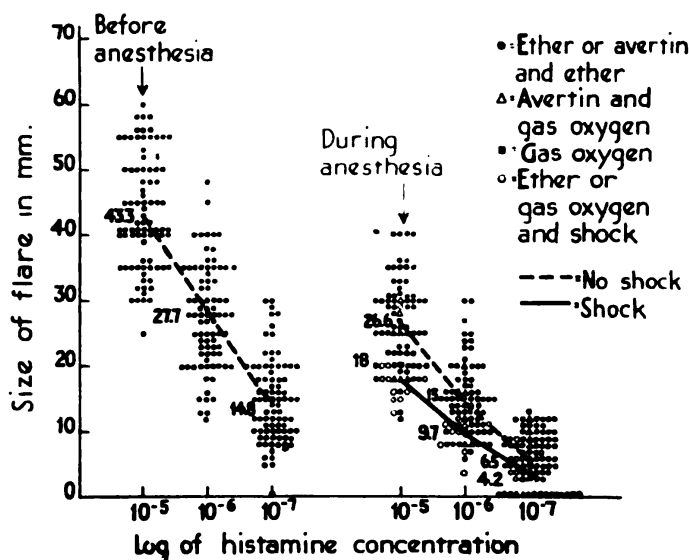


FIGURE 2.

Spinal anesthesia.—Under spinal anesthesia no significant changes in the size of the histamine flare were observed in a series of 17 cases. In 5 cases in which shock occurred, however, there was a decrease in the size of the histamine flare (table 3 and fig. 3). Results in the arm and leg (i. e., above and below the level of anesthesia) during the spinal anesthesia were essentially the same.

TABLE 3.—Averages of histamine flare size under spinal anesthesia

Histamine concentration	Control before anesthesia (22)	During spinal anesthesia (17)	During spinal anesthesia and shock (5)
1:100,000.....	<i>Mm. flare</i> 42.4	<i>Mm. flare</i> 37.8	<i>Mm. flare</i> 27.1
1:1,000,000.....	25.6	22.6	15.4
1:10,000,000.....	12.1	11.5	6.8

Numbers in parentheses represent number of cases.

EFFECT OF SPINAL ANESTHESIA ON HISTAMINE FLARE

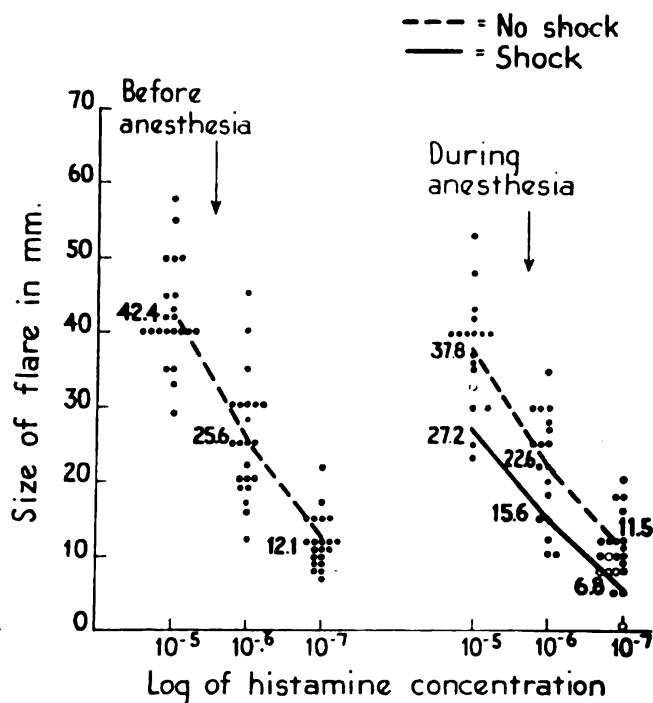


FIGURE 3.

Intravenous pentothal anesthesia.—Patients under intravenous pentothal sodium anesthesia showed no significant change in the size of their histamine flares. Only 10 cases were studied with this anesthetic, and the average duration of anesthesia was about 30 minutes. There were no cases of shock in this group (table 4 and fig. 4).

TABLE 4.—Averages of histamine flare size under intravenous pentothal anesthesia

Histamine concentration	Controls before anesthesia (10)	During anesthesia (10)
	<i>Mm. flare</i>	<i>Mm. flare</i>
1:100,000.....	41.6	39.7
1:1,000,000.....	25.4	26
1:10,000,000.....	13.7	12.7

Numbers in parentheses represent number of cases.

Shock.—Four cases of shock uncomplicated by anesthesia were studied. Two were cases of traumatic shock, one of stab wounds of the abdomen with intra-abdominal hemorrhage, and one of acute peritonitis secondary to small-bowel perforation. All four showed smaller histamine flares during shock than they did after recovery. Five cases of shock during spinal anesthesia and 14 cases of shock during

EFFECT OF SHORT PENTOTHAL ANESTHESIA ON HISTAMINE FLARE

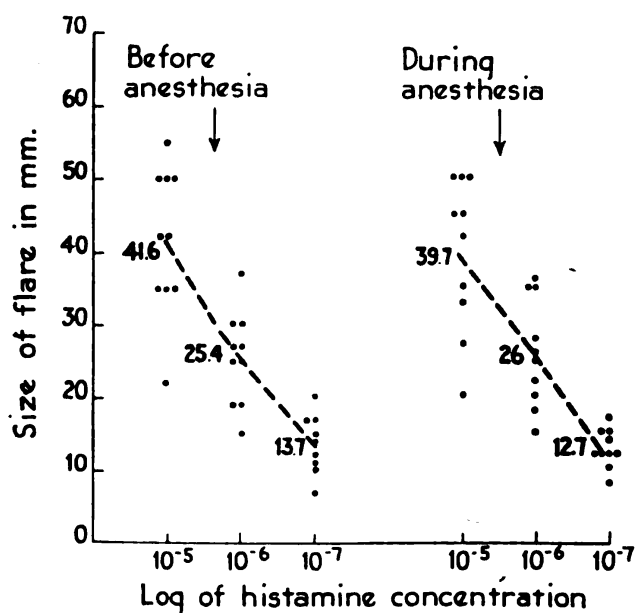


FIGURE 4.

ether or gas-oxygen anesthesia were also studied. All of these cases showed decrease in the size of the histamine flare from the normal values (table 5 and fig. 5). The cases which showed the lowest values for the histamine flare were those in which shock and ether anesthesia were combined. One patient in shock following an operation under spinal anesthesia was studied while in shock and again 90 minutes later after she had recovered from shock, having received an infusion and transfusion. While in shock, the flares were very small, but after recovery from shock, the size of the histamine flares had reached normal value.

TABLE 5.—Averages of histamine flare size in cases of shock

Histamine concentration	Control before or after shock (20)	During shock without anesthesia (4)	During shock and ether or gas-oxygen anesthesia (14)	During shock and spinal anesthesia (5)
	<i>Mm. flare</i>	<i>Mm. flare</i>	<i>Mm. flare</i>	<i>Mm. flare</i>
1:100,000.....	42.9	28.5	19.5	27.5
1:1,000,000.....	26.5	18.8	10.3	17.6
1:10,000,000.....	13	7.8	3.8	7.5

Numbers in parentheses represent number of cases.

Natural allergens.—Twenty-four cases were studied in which there was sensitivity to one or more of the natural allergens mentioned above. It was found that the skin flare from natural allergens, like that from histamine, diminishes during ether anesthesia and during shock (fig. 6).

EFFECT OF SHOCK ON HISTAMINE FLARE

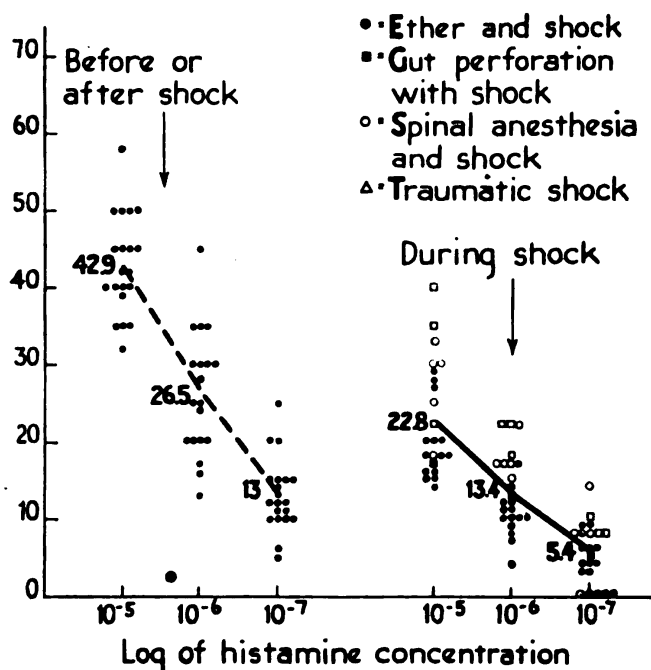


FIGURE 5.

The solutions used to test for these natural allergens were in the majority of cases not strong enough to cause wheals, but merely caused flares which could be measured more accurately than irregular wheals. In one case, however, in which 0.05 cc. of horse serum was used preparatory to injecting tetanus antitoxin, there occurred a large wheal and a flare. When this patient was tested after being under ether for an hour, it was found that the wheal had not changed in size, but the surrounding flare was considerably smaller. One patient in traumatic shock tested with horse serum, developed a flare which was smaller than the flare developed after the patient had recovered from shock. This patient was only mildly sensitive and did not develop a wheal. Four cases under spinal anesthesia showed no change in the size of the skin flare from natural allergens.

SUMMARY

The effects of anesthesia and shock on the size of the skin flares from intradermal injections of histamine and natural allergens were studied. The histamine flare was found to be smaller in those patients who had received ether or nitrous-oxide anesthesia for thirty minutes or longer. Intravenous pentothal anesthesia did not affect the size of the flare when used for 30 minutes. Spinal anesthesia likewise

EFFECT OF ANESTHESIA OR SHOCK ON SKIN TEST WITH ALLERGENS

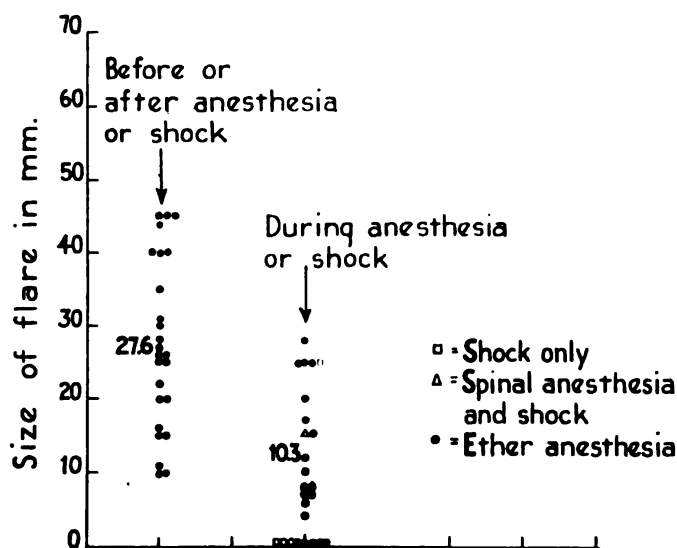


FIGURE 6.

had no effect. Cases of shock uncomplicated by anesthesia showed some diminution in the size of the histamine flare, and those patients in whom ether anesthesia and shock were combined showed the greatest decreases in the size of the histamine flares and the lowest absolute values. The skin flares from intradermal injections of natural allergens also showed a decrease in size under ether anesthesia and in cases of shock. In no case, however, did a strongly positive reaction become negative under anesthesia or shock.

CONCLUSION

Prolonged ether and gas-oxygen anesthesia and also the state of shock decrease the reactivity of the skin to injections of histamine and of natural allergens.

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MENTAL SYMPTOMS FROM ATABRINE THERAPY

The appearance of mental symptoms during or following the administration of atabrine in curative dosage has been reported by many observers. * * * J. W. Field in Bulletin 2 of 1938 from the Institute for Medical Research, Federated Malay States, says that there is a fairly characteristic clinical course of events. Toward the end of the usual 5- to 8-day course of oral atabrine, or perhaps a few days after treatment has been finished, the patient begins to behave strangely, becoming more or less excited, voluble and confused, or occasionally maniacal. He is mentally disturbed for about a week and gradually returns to normal without special treatment. This clinical picture, or atabrine psychosis, appeared in 13 cases among 700 treated during one period in Ceylon, 6 cases among many thousands treated in Kuala Lumpur and 4 cases in approximately 9,000 treatments in Malaya. Field concludes that the incidence of atabrine psychosis may tentatively be placed at less than one in a thousands cases treated. The incidence of mental symptoms during or subsequent to the administration of atabrine in the Western Hemisphere appears to have been at least equally small. There have been no reports of mental symptoms as a result of the administration of atabrine in prophylactic dosage. Confusional psychoses sometimes occur as a direct result of malarial infection, and some patients under treatment for malaria may have preexisting mental abnormality. Therefore it should not be assumed that every mental aberration following treatment with atabrine is necessarily due to atabrine.—Current comment: Mental symptoms following the use of atabrine. *J. A. M. A.* 121: 765, March 6, 1943.



VITAMINS AND GINGIVITIS

There is sufficient clinical and investigative evidence that the majority of cases of ulceromembranous gingivitis are primarily due to a vitamin-B₂ complex and vitamin-C deficiency.—Jacobs, M. H.: Pericoronal and Vincent's infections; bacteriology and treatment. *J. Am. Dent. A.* 30: 397, March 1, 1943.

THE USE OF THE CHOLEATE PRINCIPLE IN THE TREATMENT OF TUBERCULOSIS¹

LESLIE A. McCLINTOCK²

and

RAYMOND H. GOODALE
Commander (MC) U. S. N. R.

The evident failure of chemotherapy in tuberculosis has possibly been due to the inability of bacteriostatic agents, such as the sulfonamides, to penetrate the wax matrix of the tubercle bacillus. Kolmer, Raiziss, and Rule (1) reported that intramuscular injections of sulfanilamide were without demonstrable effect upon experimental tuberculosis in guinea pigs. Heise and Steenken (2) reported that tubercle bacilli grown in vitro were not markedly inhibited even when concentrations as high as 80 mg. percent of sulfanilamide were used. They also reported that inhalation tuberculosis produced by relatively small doses of tubercle bacilli was not inhibited even after the guinea pigs received treatment with sulfanilamide for 5 months.

Follis and Rich (3), however, reported that sulfanilamide used in tuberculous rabbits and guinea pigs, given in adequate doses and properly administered, produced definite inhibition of the tuberculous process. The confused state of the work on the sulfonamides and the inability of investigators to agree upon anything definite makes one skeptical as to the efficacy of these drugs. We have found in experimental tuberculosis that sulfanilamide, sulfapyridine, and sulfathiazole injected subcutaneously as a suspension failed to alter the progress of tuberculosis in guinea pigs even when very large doses were given. Our experiments in vitro showed that no demonstrable sulfanilamide exists in the tubercle bacillus after 4 days incubation in a solution of 100 mg. percent of the drug.

Feldman, Hinshaw, and Moses (4) reported that promin (p,p'-diaminodiphenylsulfone-N,N'-dextrose sulfonate) inhibits the development of tuberculosis in guinea pigs infected with virulent strains of tubercle bacilli. A further study of promin showed that the action of this drug was due to the splitting off of para-aminobenzenesulfone in vivo. This substance has been found to be the most effective para-aminobenzenesulfonamide compound yet tried.

This failure of sulfonamides to produce a more marked effect upon the development of tuberculosis appeared to be due chiefly to the inability of the drugs to penetrate the organisms. We, therefore, tried to devise a method of penetrating the lipoid barrier with such

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² Research Chemist, City Hospital, Worcester, Mass.

a compound. Numerous sulfonamides containing acyl chains of varying lengths and structures were synthesized and to these we attempted to condense desoxycholic acid molecules by means of the choleic acid principle of Wieland (5). This type of compound (acylated sulfonamides), specifically N'dodecanoyl sulfanilamide, was also synthesized by Crossley, Northey, and Hultquist (6). This drug was reported by Climenko (7) to be capable of inhibiting growth of tubercle bacilli in vitro and in vivo. However, Muschenheim, et al. (8) failed to demonstrate any inhibitory effect by N'dodecanoyl sulfanilamide on tuberculosis in rabbits.

The complexes formed by the choleic acid principle of Wieland are supposedly coordination compounds combined by secondary valence links and have chemical properties consistent with both compounds in the molecule. The molecules thus attached to desoxycholic and apocholic acids are not altered chemically except in the case of tautomeric compounds existing in keto-enol equilibrium (9). These occur only as enolic complexes, no keto form being known. As a result of this unusual combination property of desoxycholic acid, a possible means of transport is offered to potential bacteriostatic agents into the tubercle bacillus.

Freedlander (11) showed that certain wetting agents exerted a rather decided bacteriostatic effect in vitro upon the growth of the tubercle bacillus. Because of this it appeared that another advantage would be manifest in the use of a choleate. The bile acid series is known to lower the surface tension of solutions containing them.

Attempts to combine sulfanilamide directly to desoxycholic acid by the choleic acid principle failed. No choleate could be formed, probably because of the reactive nature of the two ring substitutes. However, as previously mentioned, acyl chains containing 10 to 20 carbon atoms were attached to the sulfanilamide, and to a number of these sulfonamides the desoxycholic acid apparently condensed. The condensation apparently took place along the fatty acid chain. On several trials isomeric acyl chains were used. The substance covered in this paper is, however, the constant crystallizing product obtained from sulfapyridine and desoxycholic acid. Chemically this appears not to be a true choleate. Biologically it has properties of its own. It contains the sulfapyridine and bile acid in proportions of about 1:5, crystallized with one mole of methyl alcohol. The potassium salt of this drug was used in all experiments but one, in which an acid suspension was used. We called this drug "sulfapyridine choleate complex."

EXPERIMENTS

Incubation experiments were first carried out with this drug in vitro to determine its actual effect upon the tubercle bacillus. Tubes were

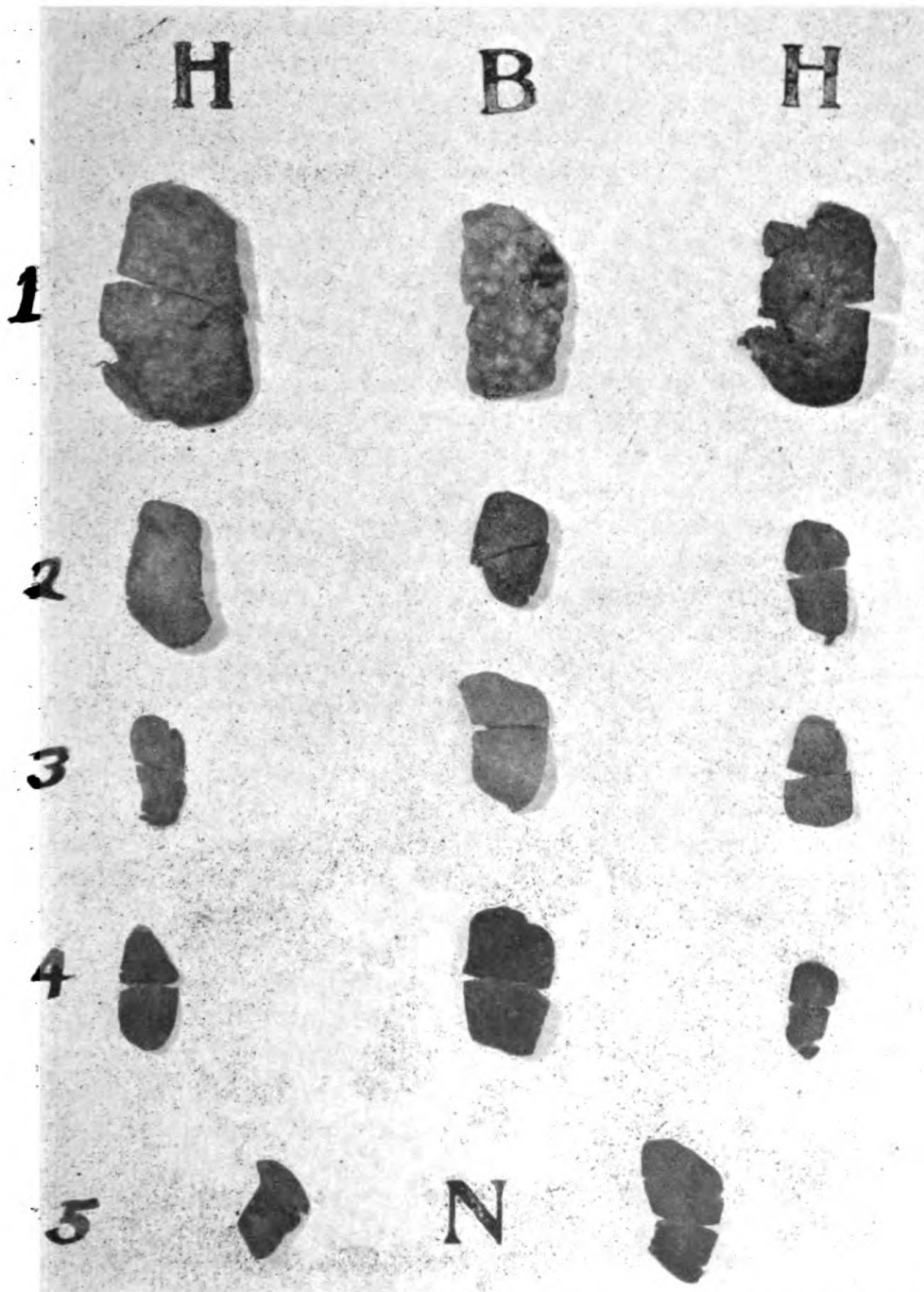
prepared each containing 5 cc. of a saline suspension of a virulent strain of human tubercle bacilli containing 1 mg. per cubic centimeter. To one set of tubes a solution of the potassium salt of the sulfapyridine complex was added so that the concentration of the drug was brought up to 12 mg. percent in each tube. A similar number of tubes in another set minus the drug constituted the controls. The tubes were placed in a 37° C. incubator and allowed to remain for 2, 4, 6, etc. days up to 16. On the proper days the treated suspension and the control suspension were injected into guinea pigs. The pigs were killed 5 weeks after injection. The treated suspensions incubated for 2, 4, and 6 days showed tuberculosis grossly and microscopically in all of the parenchymatous organs of the guinea pigs. However, the treated suspensions incubated 8 days and longer produced neither gross nor microscopic tuberculosis in the injected animals. All pigs injected with the control suspensions showed extensive gross and microscopic tuberculosis.

The next experiment was an attempt to treat tuberculosis in guinea pigs. Four groups of animals were used. Each group was composed of fifty 1-pound guinea pigs. In groups 1, 2, and 3, three different strains of human tubercle bacilli were used, and in group 4 a virulent strain of bovine tubercle bacilli was used. Each animal was injected with 0.1 mg. of tubercle bacilli in the left groin. In groups 1 and 2, 40 animals were treated by injecting 200 mg. of the potassium salt of the choleate complex per day for 4 days subcutaneously into both groins of each pig. Treatment was begun on 20 animals from each of these groups 7 days after infection. Ten animals from each group were kept as controls. Treatment of the remaining 20 animals in each group was begun 14 days after infection. At the end of the first week after injecting the drug, necrosis developed at the injection sites. As a result of the necrosis plus coccidiosis a total of 16 animals died in both groups. Thirty-five days after injection 8 of the animals from each treated group were killed. All organs of these animals were negative for tuberculosis grossly and microscopically.

Sixteen animals from the groups in which treatment was begun on the 14th day were sacrificed 35 days after infection. The organs of these animals were also negative for tuberculosis (fig. 1). At 35 days the controls had begun to die of tuberculosis. Grossly and microscopically all organs and lymph nodes showed extensive caseous tuberculosis.

At the end of 45 days the remaining pigs from each treated group were sacrificed. All of these animals with the exception of one were negative grossly and microscopically for tuberculosis. All of the controls remaining were sacrificed at this time, and all showed extensive tuberculosis.

Because of the serious necrosis produced by the potassium salt of the choleate complex, it seemed advisable to use a lower pH. A solution of the complex was prepared at a pH of 5.5 to 6. Another group of 50 guinea pigs was infected with a virulent strain of human



1. SPLEENS FROM GUINEA PIGS INOCULATED WITH "H" (HUMAN) AND "B" (BOVINE) TUBERCLE BACILLI. 1. TUBERCULOUS SPLEENS FROM UNTREATED CONTROLS. 2, 3, 4. NONTUBERCULOUS SPLEENS FROM TREATED GUINEA PIGS. 5. NORMAL CONTROL SPLEENS.

tubercle bacilli and allowed to develop the disease for 15 days. At this time 1 cubic centimeter of the suspension containing 200 milligrams of the drug was given subcutaneously in the groin opposite the site of infection. This treatment was given four times in as many days. A total of 800 milligrams of the drug was injected. Starting 17 days after infection 1 pig per day was killed, and microscopic sections were made from the organs. The last pig was sacrificed 48 days after infection. All but one of the animals were negative. This animal showed gross and microscopic tuberculosis and an unabsorbed pocket of the drug in the groin. The controls died of tuberculosis within 35 and 48 days.

The fourth experiment in which a bovine strain of tubercle bacilli was used gave identical results with those obtained with the human tubercle bacilli. The treated animals received a total of 800 milligrams of the drug and were negative for tuberculosis at the end of 45 days. The progress of the tuberculosis in the controls was slower than in the experiments with human tubercle bacilli. Eighty percent of the controls had to be sacrificed at the end of the experiment, but all of them showed caseous tuberculosis.

A control experiment in which the two components, sulfapyridine and sodium desoxycholate, were mixed together without processing and injected in the same amounts failed to inhibit tuberculosis in guinea pigs. Another experiment in which three times the standard dose of this mixture was used likewise failed to show any inhibition of the disease. It seems, therefore, that the choleate-sulfapyridine complex has therapeutic properties for tuberculosis which a simple mixture of the two drugs, sodium desoxycholate and sulfapyridine, does not possess.

It is admitted that the duration of the experiment was too short to give final conclusions as to the efficacy of this complex, but the war has prohibited a repetition of the work at this time.

Clinical trial of the drug was also limited and inconclusive. However, a tuberculous skin lesion of the nose of a 10-year-old boy cleared up in 4 months following daily application of the drug. He had had the lesion for 3 years previous to treatment. Also a case of tuberculous empyema of the right chest in a young woman was made free of tubercle bacilli by smear and by guinea-pig inoculation after 5 months.

SUMMARY

In vitro a 12 milligram percent solution of the potassium salt of the sulfapyridine-choleate complex appears to inactivate tubercle bacilli after 8-days' incubation.

The ability of the drug to inhibit the growth of tubercle bacilli in vivo has been borne out by animal experiments. Out of 160 treated

animals, 31 died as a result of the combined action of the drug and coccidiosis. Of the remaining 129 animals 2 showed tuberculosis grossly and microscopically. All of the others were negative. Most of the controls died within 50 days of extensive tuberculosis. It is felt that this complex exerts an inhibitory effect on the tubercle bacillus *in vitro* and *in vivo*.

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Among the "Estimated number of selectees rejected in 1941 for physical defects, dental defects were the cause for rejection of 188,000 (approximately one out of five) men considered unfit for service".—Robinson, H. B. G.: Dental caries and the metabolism of calcium. *J. Am. Dent. A.* **30**: 358, March 1, 1943.

OBSERVATIONS ON THE GROWTH OF *ENTAMOEBA HISTOLYTICA* IN MEDIA CONTAINING SULFATHIAZOLE¹

PRELIMINARY REPORT

WILLIAM W. AYRES

Lieutenant (MC) U. S. N.

The discovery by Boeck and Drbohlav (1) in 1925 of a method of cultivating *Entamoeba histolytica* in vitro has contributed much information concerning the pathogenicity and physiology of this intestinal parasite. However, the source of all cultivated strains of this amoeba is the human stool containing also an unknown number of species of bacteria. Boeck and Drbohlav recognized that the fermentative activity of the bacteria accomplishes a change in the reaction of the medium and ultimately causes the death of the amoebae through the accumulation of toxic metabolic products. Similar observations have been made by many other investigators and it is generally recognized that certain species of bacteria may destroy the amoebae in culture. In particular the presence of certain bacteria may prevent the initiation of amoebic cultures from stool inocula and thus limit the usefulness of the cultivation method as a means of diagnosis. Up to the present time all attempts to cultivate the amoeba without bacteria have failed. Chinn (2) et al. (1942) demonstrated that a number of single species of bacteria are satisfactory symbionts and other species are not satisfactory symbionts for the growth of *Entamoeba histolytica*. These authors employed the method of micro-isolation as developed by Rees (3) (1939) which requires the use of precision equipment not commonly available.

The data of this paper suggest that sulfathiazole may inhibit the activity of certain species of bacteria that are harmful to the amoebae, and, therefore, that this drug may serve as a useful adjunct in media that are used for the cultivation of *Entamoeba histolytica*.

CULTIVATION EXPERIMENTS

The medium for most of these cultivation experiments was that recommended by Craig (4) (1940), consisting of human serum one part and Locke's solution seven parts, with the exception that cornstarch was used rather than rice starch. Also powdered sulfathiazole was added to the heated Locke's solution to make a 60 mg. percent solution. With several exceptions these experiments were performed from September through November 1941 at the United States Naval Hospital, Canacao, P. I., with material obtained from a patient having

¹ Received for publication August 31, 1942.

acute amoebic dysentery. It was found that *Entamoeba histolytica* grew better in media containing sulfathiazole than in control media containing no sulfathiazole. The media containing sulfathiazole did not become markedly turbid, change color or develop an odor of putrefaction even after 10 days' incubation. The control media containing no sulfathiazole became markedly turbid, turned a blue-green color due to the presence of *B. pyocyaneus*, and developed an odor of putrefaction after a few days. This strain of amoebae could not be maintained in Craig's Locke-serum medium containing no sulfathiazole. After the initial stimulation in growth of the amoebae in this medium containing sulfathiazole, they gradually decreased in number through 5 subcultures. However, if the amoebae were subcultured into media containing sulfathiazole and two full platinum loops of *Escherichia coli*, there was a marked increase in the number of amoebae. *Escherichia coli* did not have this stimulating action on the amoebae in media not containing sulfathiazole. (*Escherichia coli* was grown on Endo's plates).

The following experiment illustrates the stimulating action of *Escherichia coli* on *Entamoeba histolytica* in culture. *Entamoebae histolytica* were inoculated into the following groups of media:

Group 1.—Craig's Locke-serum medium containing 60.38 mg. percent sulfathiazole and *Escherichia coli*. Excellent growth of amoebae.

Group 2.—Craig's Locke-serum medium containing 60.38 mg. percent of sulfathiazole but no *Escherichia coli*. Poor growth of amoebae.

Group 3.—Craig's Locke-serum medium containing 0.38 mg. percent sulfathiazole and *Escherichia coli*. Poor growth of amoebae.

Group 4.—Craig's Locke-serum medium containing 0.38 mg. percent sulfathiazole but no *Escherichia coli*. Poor growth of amoebae.

(The culture used for inoculation contained a small amount of sulfathiazole which explains its presence in groups 3 and 4.)

Entamoebae histolytica were also inoculated into nutrient broth containing 10 mg. percent sulfathiazole and 25 mg. of sterile corn-starch. In this medium the amoebae survived for 9 days. The amoebae did not survive in nutrient broth containing no sulfathiazole. Attempts to subculture the amoebae from nutrient broth containing sulfathiazole into the same media were unsuccessful.

Excellent growth of *Entamoeba histolytica* was also obtained in the liver infusion agar medium devised by Cleveland and Collier (5) (1930), with the addition of sulfathiazole.

The following observations were made on washed human erythrocytes that were ingested by *Entamoeba histolytica* in media containing sulfathiazole. The erythrocytes were ingested voraciously. After the cytoplasm was almost completely filled with erythrocytes, the erythrocytes were extruded through the following end of the advancing amoebae. The ectoplasm became thickened around an erythrocyte, then by compression elongated the erythrocyte and forced it

rapidly through to the exterior. Several erythrocytes could be extruded by an amoeba simultaneously. Some of the erythrocytes after extrusion regained their normal circular shape, were smaller, and did not show a central concavity. Other erythrocytes remained in a fusiform shape after extrusion. A few of the fusiform erythrocytes were observed to spring back into the circular shape in an elastic manner.

No cysts were observed in the cultures.

Binary fission was observed, once in an amoeba containing numerous erythrocytes.

DISCUSSION

The data of the present preliminary paper shows the need of more extended researches on the effect of sulfathiazole and other sulfa drugs on *Entamoeba histolytica*. Craig's Locke-serum medium, without sulfathiazole, is one commonly employed in the diagnosis of amoebic infections. The usefulness of this method is limited by the presence of certain bacteria in stools that may prevent the growth of *Entamoeba histolytica* in vitro. By retarding the growth of the bacteria in question, sulfathiazole may remove some of these limitations.

SUMMARY

1. The addition of sulfathiazole to Craig's Locke-serum medium resulted in an initial stimulation of growth of one strain of *Entamoeba histolytica* in mixed bacterial culture; this stimulation was not as marked on subculture in media containing sulfathiazole.
2. The addition of *Escherichia coli* resulted in stimulation of growth of one strain of *Entamoeba histolytica* in mixed bacterial culture in Craig's Locke-serum media containing sulfathiazole.
3. Sulfathiazole in concentrations of approximately 60 mg. percent did not appear to be toxic to *Entamoeba histolytica*.
4. The mechanism of extrusion of human erythrocytes from *Entamoeba histolytica* is described.

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FUNCTIONAL AND SIMULATED DEAFNESS

(CONCLUDED)

FRED HARBERT

Commander (MC) U. S. N.

A loud watch or small clock, high-pitched forks, or Galton whistle set at a medium setting may be used in testing unilateral deafness for consistency. The maximum distance at which these sounds are heard by the good ear is recorded and is usually found to be over 3 feet. If the bad ear is now similarly tested, with the good ear unobstructed, hearing may be denied completely or only admitted when the instrument is at the pinna of the bad ear. Obviously even if the bad ear were totally deaf, he should hear the sounds in the good ear at much greater distances from the bad ear. Even with finger occlusion of the good ear it is difficult to exclude the high pitched sound of these instruments.

The stethoscope test has been popular as a method of disproving alleged unilateral deafness. In its simplest form an ordinary diaphragm type stethoscope is inserted in the patient's ears and the bell is gently tapped, the patient counting the number of taps (36). A ticking watch or tuning fork may also be used as a source of sound. The tube leading to the good ear is then pinched off and if he still counts correctly, the inference is that he heard with the alleged deaf ear. This test is not satisfactory because the taps may be heard by the good ear either by air conduction around the ear piece or by conduction along the rubber. In order to conclude that it was really the alleged bad ear that heard, the ear piece must be removed from the bad ear and the test repeated with the tube to the good ear pinched off. If the patient is now unable to count the taps or hear the watch and fork we conclude that he previously heard with the bad ear. Should he still be able to signal correctly no conclusion can be reached because he may have heard them with either ear.

A variation of the stethoscope test described above is to connect funnels to two long rubber tubes, the other ends of which are attached to the stethoscope. The tube leading to the alleged deaf ear should preferably be shorter. One examiner reads into the funnel connected with the good ear and the patient is instructed to write down or repeat what he hears. When his ability to do so has been well established, another examiner reads about a dissimilar subject into the funnel connected to the bad ear. Because of the confusion produced by the dissimilar subjects, the patient who really hears in the alleged bad ear is no longer able to repeat what he hears in the good ear.

This test has not proven satisfactory when tried on a series of controls. Most subjects tested could readily dissociate the two speakers' voices during the test and accurately repeated what was said to them in one ear, even though they had normal hearing in the other.

Another variation of the stethoscope test depending on the Stenger principle is often effective. The bell of a stethoscope is connected to the earpiece by tubes of unequal length (ratio 3 to 1) and any source of sound such as a tuning fork, watch, or even the voice is used. The sound is much louder in the ear connected to the short tube and if this is in the good ear, the patient readily admits hearing it. If now the stethoscope is reversed, the sound is so loud in the alleged bad ear if it has good hearing that the patient is unable to tell whether he hears any sound in the good ear. Therefore he may deny hearing all sound.

When one earpiece of an ordinary stethoscope is plugged with wax and alternately inserted first in the good ear and then in the bad ear, the patient with alleged unilateral deafness may state that he hears equally well in both positions to convict himself of inconsistency. It is so easy to distinguish which ear is hearing the sound however, that this test is rarely successful. If an earpiece plugged with wax is inserted in the good ear of the patient and he is tested for speech in the bad ear, marked deafness is usually alleged if the patient realizes the earpiece is plugged, and care is taken to be sure he does. On the pretense of adjusting the plug, a patent plug is now inserted and the test repeated. If the hearing does not now markedly improve and approach the best hearing in the good ear, he is inconsistent.

FORK TESTS

In testing the hearing time for forks it is advisable to use low intensities at first and increase this as found necessary. Weber (24) activates a fork by squeezing the prongs together and releasing them suddenly. After the fork has subsided considerably, he strikes another fork loudly and obviously but discards it immediately and places the attenuated fork beside the ear to be tested. If the patient now admits hearing this attenuated fork as long as he previously admitted hearing the actively vibrating fork, he is obviously inconsistent.

Another variation of this procedure is forcibly to activate a fork but dampen it with the fingers as it approaches the pinna. Patients who count to themselves or otherwise decide on how long they should admit hearing the forks are often fooled by this method into admitting normal hearing. Such patients are also at a loss about what to do if they are first timed by a fork of the Hartman series and then with a magnesium fork of the same frequency. Often glaring

inconsistencies result, such as alleging the hearing time for both forks to be the same. Obviously the hearing time for the magnesium fork should be several times longer than for a Hartman fork.

The Teal test was devised to demonstrate air conduction when this is denied although good bone conduction is admitted. This contention is rare in volitional deafness unless the patient has been coached. A high-frequency fork is employed to minimize tactile sensation and the hearing time by bone conduction is recorded. An inactive fork is then placed over the mastoid while simultaneously a vibrating fork is held beside the pinna. If the patient now signals he hears, he is inconsistent if he has previously denied air conduction. Normal controls can readily distinguish whether hearing is by air or bone and the test usually fails. A variant that is more often successful is to employ two similar vibrating forks. One is applied beside the pinna and the other over the mastoid. The one over the mastoid is gradually dampened and at the same time the fork beside the pinna is advanced nearer to the ear thus making up for the decreased sensation produced by stilling the bone conduction fork. If there is really good hearing by air conduction in the bad ear, the loss of bone conduction may not be noticed.

Most cases of volitional deafness refer the Weber to the good ear and admit no bone conduction over the mastoid of the alleged deaf ear. If a finger is now placed in the external canal of the good ear, a simulator may deny all hearing. Actually the sound is increased by finger occlusion. Becker (44) masks each cochlea in turn by directing a stream of air against the tympanic membrane while testing bone conduction over the mastoids and vertex. In volitional deafness, the patient may state he still hears well by bone conduction over the mastoid of the good ear and refer the Weber to the good ear from the vertex while the good ear is masked, thus demonstrating inconsistency.

MASKING TESTS

In order to mask an ear a stream of water, air or sound may be directed into it. The principle of masking depends on the physiological fact that near the upper limit of hearing it requires a tremendous increase of power loudness to produce a sensation of increased loudness, while at the threshold an infinitesimal amount suffices. In masking, a sound close to the upper limit of hearing (about 80 decibels) is introduced in one ear to eliminate it while the other is tested. For this purpose a complex sound of low frequency is best. This can be produced by the Bárány noise apparatus, a telephone receiver connected to an AC current through a door bell or toy transformer or potentiometer (41), or a masking device provided by commercial companies in conjunction with various audiometers may

be used. A simple improvised masking device is a sheet of glazed paper rapidly rubbed about the pinna of the ear to be masked. The earpiece of the audiometer set at maximum intensity of frequency 128 may also be used.

During the cold caloric mass douching in testing vestibular function, the douched ear is completely masked. Any hearing demonstrated while one ear is being irrigated must be perceived by the other. While the good ear is being irrigated is a good time to make solicitous inquiries or give instructions in cases of suspected volitional unilateral deafness. When the dizziness produced by douching the normal ear becomes manifest, responses are often obtained in the resulting confusion.

There are various devices for blowing air into an ear to produce masking. One of the simplest is that devised by Shapiro (42) who uses a Politzer bag and diagnostic tube with a $\frac{1}{16}$ inch hole in the wall of the tube to avoid injury to the tympanic membrane. Kafka uses a more complicated set-up utilizing a hand bulb (43). A continuous stream of air may be obtained from the air compressor used for spraying, or the examiner or his assistant may blow his breath through a tube directed into the ear to be masked.

The Bárány noise apparatus is a valuable simple tool to test for inconsistency. It is placed beside and later in the external auditory canal of the alleged deaf ear in unilateral deafness, and the patient is asked if he hears it. Often he denies hearing it, thus convicting himself of inconsistency because obviously the loud noise should be heard by the good ear even if the unilateral deafness is bona fide. If he states he hears the sound in his good ear, the instrument is held beside the good ear and he readily admits hearing it. Next it is placed in the external canal of the good ear and while it is vibrating he is asked if it is much louder or some other question. If he answers, he must obviously hear with the alleged deaf ear because the noise completely masks the good ear. If some hearing is admitted in the deafened ear an estimate of the hearing can be made by having an assistant hold the apparatus in the good ear while the examiner recedes behind the patient while engaging him in conversation or asking questions about the test. The greatest distance at which the patient responds to these questions is a measure of his residual hearing.

The Lombard test is very useful in unilateral deafness. If the voice rises markedly with a Bárány apparatus in the good ear, the presence of genuine deafness is strongly indicated. If the voice does not rise when the good ear is thus masked but does when both the good and bad ears are masked simultaneously, hearing in the alleged deaf ear is demonstrated. Often, instead of a rise of voice during the bilateral Lombard test, patients develop a mumbling sort of monotone

with very poor enunciation. It has been noted that such a large number of functionally deaf exhibit this phenomenon that it may be considered highly suggestive if not diagnostic of this condition.

STENGER AND STENGER-PRINCIPLE TESTS

The Stenger test depends on the principle that when both ears hear similar sounds of unequal loudness, only the louder is registered in consciousness and the sound is lateralized to that side. Two Edelmann forks of 440 frequency are employed because of their slight carrying power to prevent hearing in the opposite ear when applied near one. If both forks are simultaneously activated and one held beside each ear, only the nearer fork can be heard and the sound is lateralized to that ear. If the other fork is slowly withdrawn no appreciable change in sensation is produced.

The Stenger test is one of the most valuable inconsistency tests and can be roughly quantitative as well. To perform it, the time of hearing one Edelmann fork at 4 or 5 inches from the good ear is recorded after a standard activation. Malingerers usually are anxious to demonstrate how well they hear in the good ear in order to emphasize the hearing loss in the alleged deaf ear. The functionally deaf may give inconsistent results and it is often necessary to bolster their attention by nudging or moving the fork away and back again frequently. The patient signals when he hears by raising his finger or preferably the entire hand during the period he hears the sound. When the hearing time for the good ear has been established, the alleged deaf ear is similarly tested. Hearing is either denied completely or markedly reduced. Both forks are now simultaneously activated. One is applied at the standard distance (4 to 5 inches) beside the good ear and the patient signals that he hears. The other fork is then placed $\frac{1}{2}$ inch from the pinna of the alleged deaf ear. If there is no hearing in the deaf ear, the patient continues to signal that he hears the fork in the good ear. If hearing is good in the alleged deaf ear, the sound is so loud in this ear that he is unable to perceive the vibrations from the fork beside his good ear and he usually signals that he no longer hears. The fork beside the alleged deaf ear is then periodically withdrawn and the patient again hears the sound in his good ear and so signals each time the fork is withdrawn. This demonstrates inconsistency because the fork beside the good ear should be heard constantly, regardless of the presence or absence of the fork beside the deaf ear. This type of response is practically universal in the functionally deaf and most malingerers. Some malingerers signal that they still hear the fork in the good ear even though they actually hear only the fork beside the alleged deaf ear. In this case, the examiner slowly withdraws the fork beside the good ear, at the same

time slightly advancing the fork beside the deaf ear to eliminate any decrease in sensation. The malingerer either continues to signal that he hears, in which case the hearing time of his alleged deaf ear can be measured, or he signals erratically.

When there is well-marked organic deafness in an alleged totally deaf ear, the findings are not so conclusive. It is still possible to elicit the same inconsistent responses, but they are present only for a short time while the forks are vibrating actively, because the threshold of hearing in the partially deaf ear is raised and the fork beside it soon becomes inaudible. It is useless in bilateral deafness where the difference in hearing between the two ears is slight.

Because of the short vibration time of the Edelmann forks, it is often difficult to reach a conclusion in an uncooperative or dull patient. A common subterfuge is to allege a very short hearing time for the fork beside the good ear in order to balk comparison. It is therefore important to record accurately the hearing time of the good ear by several trials before the purpose of the test is realized. Then a marked discrepancy developing a few minutes later is in itself evidence of inconsistency. The hysteric tends to give more uniform results by denying all hearing whenever the sound is more intense in the alleged deaf ear.

Because of the short vibration time of Edelmann forks, various authors advocate use of the Stenger principle with different test forks. Thus, Wells (39) inserts the handle of a 120 fork into one end of a $\frac{1}{4}$ -inch rubber tube 30 inches long and an earpiece in the other. The hearing time for the fork after standard activation at a standard distance from the good ear is then recorded along with the maximum distance at which the fork is heard. The earpiece is now inserted in the alleged deaf ear and the hearing time if any is recorded. With the tube behind the patient, the prongs of the fork are brought near the good ear well within the maximum distance at which it was previously heard. If the patient fails to signal that he hears, the tube is pinched off and the patient now signals that he hears, thus demonstrating inconsistency. The fork is now placed at the standard distance and the time during which confusion can be produced is recorded. If this is prolonged, good hearing can be inferred in the alleged deaf ear. When this test was tried on controls, many were able to distinguish the difference in pitch between the shank and prong vibrations and couldn't be confused. This occurred only at low intensities, however.

Becker (38) employs a rubber tube 4 feet long with an earpiece at both ends. One earpiece is inserted in the good ear and either the handle of a vibrating fork or a loud ticking watch is applied to the other. This is readily heard in the good ear. The earpieces are now inserted in both ears and the vibrating fork or ticking watch is applied to the middle of the tube. If hearing is the same in both ears, the intensity of sound will be equal. The fork is then advanced along the

tube toward the alleged deaf ear. If hearing is normal in this ear, the intensity of sound is so great that he is unaware of the vibrations in his good ear, and he usually signals that he no longer hears. If the tube to the bad ear is then pinched off, he again hears the vibrations in the good ear and by so signaling shows inconsistency.

Should he signal that he still hears the sound in the good ear even though the sound is more intense in the bad ear, the tube to the good ear is pinched off. Theoretically this should be unnoticed by the patient and he continues to signal that he hears it in his good ear, thus demonstrating inconsistency. Actually there is a change of sensation and an astute malingerer can often recognize this. In the author's hands this test has not been as satisfactory as the Stenger.

Becker also advocates a test based on the recognition of this change in sensation (38). When a long tube is connected to the bad ear and a short tube to the good ear, and both ends are connected to the bell of a stethoscope before which is a ticking watch, the patient readily admits hearing the watch in his good ear. He is requested to signal any change in the intensity of the sound and the tube to the alleged deaf ear is pinched off. This causes a slight reduction in the intensity of the sound and the patient sees no harm in so signaling, thus showing hearing in the deaf ear. If there is true unilateral deafness the sound should be accentuated.

In all tests involving rubber tubes, mere pinching of the tube does not stop all sound traveling along it (45). Sound may still travel along the walls of the tubing to the earpieces and thence to the cranial bones. To rule out bone conduction, Callahan (36) uses funnels held near the ears of the patient but not touching them, in place of earpieces. The length of the tube and the loudness of the test instrument may have to be varied to prevent hearing in the good ear by air conduction directly from the source of sound.

AUDIOMETER TESTS

The audiogram when properly and carefully done is of great value in diagnosing volitional deafness. Marked variations in hearing the same frequency, depending on whether one approaches from below the threshold of hearing or reduces intensity from near the upper limit of hearing is suspicious. The normal variation is usually 5 to 10 decibels. Audiograms made by skipping to various frequencies in no regular order should also be within these normal limits. Marked variation in audiograms taken on different days or a marked change in the character of the curve is also suspicious. An audiogram can often be obtained from functionally deaf patients by assuring them that it is realized that they cannot hear but they are requested to signal whenever they feel the vibrations. Denial of all hearing in the alleged bad ear with the audiometer set at 100 for all frequencies is inconsistent

if the hearing for the good ear is normal. Some sort of shadow curve should be obtained unless the good ear is masked.

In performing Stenger-type tests the audiometer may be used as a source of sound instead of forks. A dual fade control is necessary in order that the intensity of sound may be rapidly varied. Commercial companies provide standard boxes for this purpose making available not only all the frequencies of the audiometer, but a microphone circuit for speech testing as well. With the control, the operator can gradually fade any tone or the spoken voice from one ear to both and then to the other at any intensity level (18). Two audiometers may also be used.

The loudness balance curves of Fowler (49) usually fail to show either the parallelism of conductive deafness or the recruitment factor of nerve deafness in volitional cases. A method of not only demonstrating inconsistency but recording the audiogram of an alleged deaf ear is possible by utilizing the loudness balance principle. The audiogram of the good ear is first accurately determined. Then a sound of low intensity (15 decibels above threshold) is introduced in the good ear and a sound of the same frequency applied to the bad ear, starting from the threshold intensity and gradually increasing it until the intensity in both ears is the same. Normally, the patient would admit it when this occurs but the volitionally deaf are undecided whether they hear in the good or bad ear, so they usually deny hearing whenever the intensity of the sound in the bad ear is greater than in the good ear. Both the functionally deaf and malingerers give this response, but some malingerers may state that they continue to hear the sound in the good ear even when the intensity of sound in the bad ear is much greater. In such cases, the sound to the good ear is interrupted and at the same time intensity of sound is increased in the bad ear to prevent any sensation of decreased intensity. If he still alleges that he hears the sound in the good ear he is shown that there is no sound there. Calling his attention to one or more such inconsistencies usually causes him to admit either the true hearing for the alleged deaf ear or forces him to return to the method of denying hearing whenever the sound is louder in the bad ear. Using the same setting of 15 decibels above the established threshold of the good ear for all frequencies, a complete audiogram is obtained. Since the patient signals only when the sound in his alleged deaf ear is louder than in his good ear, the hearing loss should be further decreased by 5 decibels.

Every mental process, whether thinking, feeling, or an act of will is accompanied by certain slight unconscious movements of the head and extremities. Löwenstein (47) uses a special apparatus to detect these during hearing tests. The auditory reflexes are also often used to demonstrate the presence of hearing in alleged total

deafness. Thus an unexpected sound that causes involuntary blinking or dilatation of the pupil disproves total deafness.

Unger (48) uses this last reflex as the basis of an objective measurement of hearing. He places strong convex glasses before the eyes to eliminate accommodation and at the same time facilitate observation of the pupils. As soon as a sound from the audiometer is heard there is a sudden dilatation of the pupil followed by contraction even during the continuance of the sound. Several repetitions are required to rule out extraneous factors and the method is slow and tedious to both patient and examiner.

SUMMARY

The basis of diagnosis of functional and simulated deafness is inconsistency of findings both with the same test and by comparing different tests.

The distinguishing factor between simulation and functional deafness, is insight of the patient. The motives may be similar in both. If insight is present the patient is either psychologically normal or a constitutional psychopath. If insight is lacking, patient is either hysterical, neurasthenic, or a combination of these.

In order to establish whether insight is present, the following table may be of value:

Simulation	Hysteria	Neurasthenia
1. Distractable, alert, and cooperative at first. After prolonged examination often becomes nervous, sulky or bellicose.	Composed, aloof, indifferent. Wrapped up in himself.	Anxious, "nervous" vasomotor instability. Pathological fatigue.
2. Symptoms are dropped when not under observation. Plays a role for benefit of examiner and parties concerned only. Retains capacity for play and a good time.	Symptoms persist even when not under observation. May be aggravated by nervous tension or alleviated when composed. Under severe emotional stress, symptoms may disappear. Interferes with usual pleasures.	Symptoms persist, but vary from moment to moment. Unhappy anxious, worried, pessimistic.
3. Usually no associated symptoms.	Usually no associated symptoms but hemianesthesia or amblyopia may be present.	Usually numerous associated symptoms such as palpitation, hyperidrosis, belching, tremors, fainting spells.
4. Purpose of consulting physician is to obtain a certificate of disability. Not cooperative in carrying out treatment. Balks at suggested operations.	Desires cure, yet fears it. Cooperative in carrying out treatment. Willing to undergo operations.	Desires cure. Cooperative in carrying out treatment. Willing and anxious to be operated.
5. Inconsistencies are seldom great or obvious and become less on repetition.	Inconsistencies often great and can be repeatedly elicited. Remain fairly constant during examination.	Symptoms increase as the examination progresses due to pathological fatigue. Transient loss or aggravation of symptoms is common.
6. May show studied inattention but can often be caught off guard.	Attention suspension is characteristic and constant. Hearing improves when prodded or when the subject is interesting.	Attention is good at onset but varies markedly during examination. Attention wanes as examination progresses due to pathological fatigue.
7. Usually unilateral and constant.	Usually unilateral and fairly constant. May show transference from ear to ear.	Usually bilateral and very variable.
8. Tinnitus and vertigo usually absent.	Tinnitus and vertigo usually absent.	Tinnitus and vertigo usually associated.
9. Degree of impairment for speech and pure sound usually proportional.	Degree of impairment for speech usually greater than that for pure sound.	Degree of impairment for pure sound may exceed that for speech and findings may become reversed several times during examination.

Simulation	Hysteria	Neurasthenia
10. Usually no improvement after suggestion of treatment.	Often marked but usually temporary improvement by suggestion or inadequate treatment.	Effect of suggestion difficult to evaluate because of marked transient variability of findings.
11. History shows emphasis on inability to work or carry on in an unpleasant environment.	History shows fairly good acceptance of present state.	History emphasizes subjective sensations and self pity.

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ATHLETE'S FOOT

This happens to be the most common of the fungus infections. It has been estimated that from 75 to 90 percent of certain population groups are effected. Unlike other forms of tinea of the glabrous skin, the scaling and other changes are often hidden between the toes. Since hypersensitivity is frequent, all of the kinds of allergic manifestations can be seen.—Peck, S. M., and Schwartz, L.: A practical plan for the treatment of superficial fungus infections. *Pub. Health Rep.* 58: 337-345, February 26, 1943.

TREATMENT OF CICATRICAL ENTROPION¹

WILLIAM L. BERKLEY
Commander (MC) U. S. N.

A method of treating cicatricial entropion is herewith presented. This report, with observations covering a period of 2 years, is based upon the results of combined operative correction and sulfonamide therapy in 70 cases of trachomatous contractile entropion in American Samoa. The study includes 2 repeat operations from the early part of the series in which the original technic was considered faulty, and 2 cases which had been previously treated by partial tarsectomy. Canthotomies were necessary in 4 cases and partial corneal resections were done in 3. The lower lid was at fault in 2 cases.

The many operations described for correcting this defect attest to the unsatisfactory results of each in the hands of some operators. Satisfactory tarsoplasty in this condition must be based upon a sound understanding of the underlying mechanics and pathology producing the defect. Cicatricial entropion is generally the result of trachoma in which the tarsus has been the primary seat of the process. By pathologic hypertrophy, including fatty and cystic degeneration in the virus bearing tissue, and by consequent scar formation, the tarsus is caused to contract with resultant increase in both its lateral and horizontal concavities. This brings about trichiasis with additional ocular symptoms and corneal damage.

Treatment, therefore, should be directed toward reducing the increased horizontal concavity of the tarsus and treating the underlying disease. The basic principle for correcting this underlying defect has long been recognized and successfully utilized by many operators. Its main feature consists of a basic tarsal incision tending to reshape the tarsus toward the normal. Literature reveals that the soundness of this incision was evident even to the ancient Greeks. Green in 1880 (1) described an effective operation for entropion using the same incision. Ewing (2) later described further modification which considerably improved the operation. Indeed the operation for entropion known under the name of each of these ophthalmologists bears ample witness to their worthwhile contributions in this field. However, while later modifications and refinement in technic have continued to improve the operation, the basic tarsal incision has remained the same. The technic is simple but must be emphasized in detail if consistently satisfactory results are to be obtained.

¹ Received for publication November 17, 1942.

PREPARATION

No preliminary local treatment is given prior to operation. The patient is directed to report to the clinic at the appointed time and the usual preoperative preparations are carried out. Anesthesia is produced by instilling one drop each of a 0.5 percent solution of pantocain and 1:1000 epinephrine in each eye followed by one drop of pantocain in the eye to be operated on at three-minute intervals, until a total of four drops has been instilled. The initial pantocain in the second eye is to allay discomfort from any accidental spilling over of soap while scrubbing the operative field.

The lids, brow, and immediately surrounding area, are then gently scrubbed with soap and water, and sterile gauze. The lids and conjunctival sac are copiously irrigated with warm normal saline followed by a 2 percent protargol instillation into the cul-de-sac.

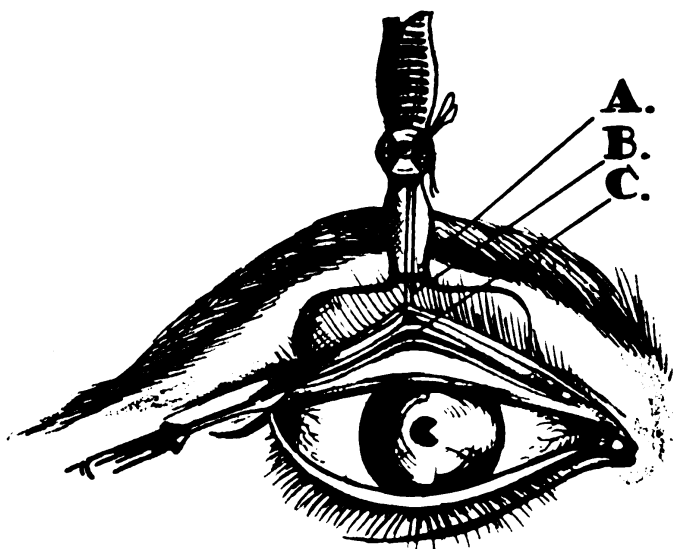
TECHNIC

The patient is then draped and, using 2 percent procaine, a small wheal is made midway on the skin surface of the upper lid just above the lash margin. A stay suture is passed from the conjunctival side through the wheal. Obtaining traction with this suture, the lid is everted over a Desmarres chalazion clamp (with the ring arm of the clamp cut away) and secured with a turn of the suture around the set screw. This simple procedure both maintains satisfactory lid eversion and gives support to the tarsus during operation. If eversion is difficult or incomplete due to severe blepharospasm, excessive scar tissue (symblepharon), or undue thickening of the tarsus, the difficulty may be easily remedied by a lateral canthotomy, following which the lid is easily everted. The upper retrotarsal fold is then moderately ballooned with procaine to which no epinephrine has been added. Care must be taken at this point to anesthetize thoroughly the two canthal angles.

With a Beard lid knife or similar instrument a horizontal incision, concentric with and about 3 mm. from the lid margin, is made through the conjunctiva and the entire thickness of the tarsus embracing its full width (fig. 1). This incision will generally coincide with a dense white linear cicatrix in the sulcus subtarsalis denoting the line of greatest horizontal concavity. Care must be given to insure complete division of the flank portions of the tarsus. Stevens' scissors may be used to advantage for this purpose. Failure to divide the tarsus completely leaves anchorage which may later result in recurrence of the defect. These final flank incisions generally result in increased hemorrhage from severing the palpebral branch (arcus tarseus) of the angular artery. Pressure quickly controls this bleeding.

Inspection of the cut edges of the tarsus may now show it to be several times its normal thickness, and honeycombed with cystic degenerations, caseation necrosis, and minute abscess formations. The cut edges are now grasped with forceps and undermined both distally and proximally to free the connection between the tarsus and the underlying skin-muscle plate. Double armed, fine twisted silk sutures on small curved cutting needles are now placed in the following manner:

Using utmost care to insure proper alinement, a mattress hold is obtained by passing the first arm of the first suture into the conjunctiva overlying the proximal tarsal segment at a point midway in the incision and 1 mm. from the edge, and bringing it out through the cut surface of the underlying tarsus. The

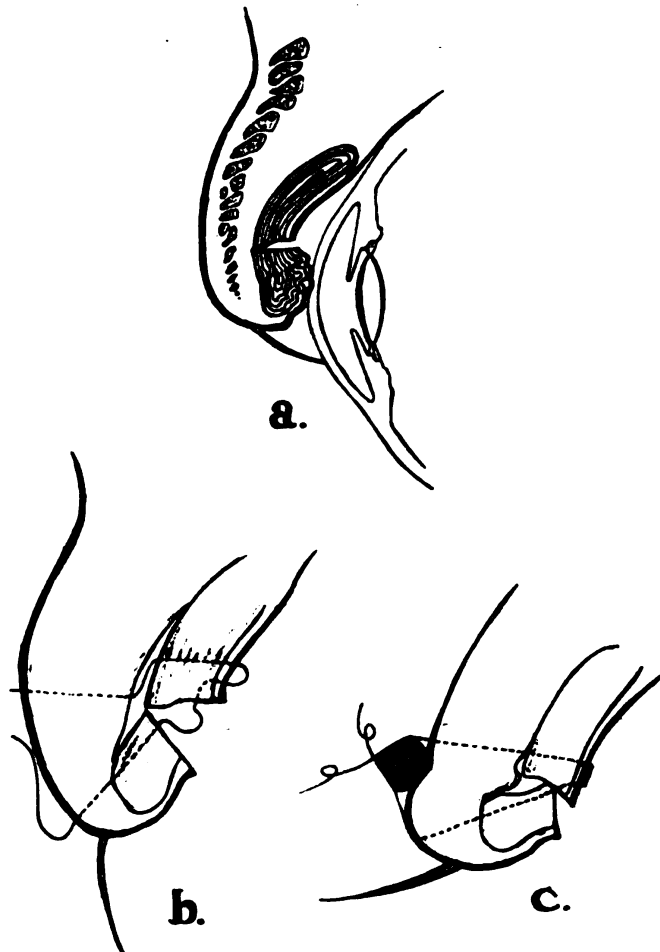


1. CICATRICAL ENTROPION, SHOWING THE LID EVERTED OVER A CHALAZION CLAMP (THE FENESTRATED BLADE) (A) CUT AWAY) AND POSITION MAINTAINED BY TRACTION SUTURE (B). WITH A ROUND-BELLIED SCALPEL AN INCISION (C) IS MADE THE LENGTH OF THE TARSUS 2 MM. FROM AND CONCENTRIC WITH THE LID MARGIN.

needle is then passed into the cut surface of the distal tarsal segment transfixing the entire segment plane and emerging through the skin surface at or just above the lash margin. With the second arm a firm bite is taken through the tarsus behind and 2 mm. lateral to the original point of entry of the first needle, and the needle is then brought out through the skin about 6 mm. behind the lash margin in proper alinement with the first arm (fig. 2b). Using alternately black and white for ease of identification, four additional sutures, two on either side of the original are similarly placed, exercising care to place the lateral ones well into the tarsal flanks. After tightening and inspecting the sutures for position and effectiveness, a dry field is assured, the traction suture severed, and the lid is righted. The sutures are now gently but firmly tied over a rubber splint of 3 by 3 by 30 mm. dimensions (fig. 2c).

A small amount of holocaine ointment is now placed in the cul-de-sac, vaseline applied over the splint, and the eye is covered with a gauze-cotton pad. The patient is placed on sulfanilamide, 15 grains (1 gm.),

four times a day, and directed to report to the clinic daily for the following 5 days for dressing and a daily supply of sulfanilamide. With a splint on the lid the patient rarely fails to follow out these instructions. On the second day the pad is left off, the eye is cleansed, and the splint is gently manipulated and again moistened with vaseline. If the second eye needs operation, it may be done at this time. After 5 days the splint is removed and sulfanilamide is discontinued



2. CICATRICAL ENTROPION IN PROFILE, SHOWING (A) THE BUCKLED TARSALE PLATE WITH RESULTANT TRICHIASIS AND THE INITIAL INCISION FOR CORRECTION; (B) THE PROPER PLACEMENT OF THE SUTURES; AND (C) FULL EVERSION OF THE LID MARGIN WITH THE SUTURES TIED OVER THE RUBBER SPLINT.

The patient begins to note increased ocular comfort within 18 hours following the lid correction and beginning of sulfanilamide therapy. At the end of 5 days the stunted irregular lashes are well away from the globe, the cornea usually shows considerable clearing associated with corresponding visual improvement, and there is complete freedom from lacrimation, scratching, and photophobia. This improvement continues for months with the vascular outer layer of the cornea gradually changing to an increasingly transparent fibrous tissue.

CASE REPORTS

CASE 1¹

History.—T., a 30-year old married Samoan woman sought treatment for sore eyes associated with photophobia, lacrimation, scratching of the lids, and impaired vision. She stated that the condition had been present for many weeks and the pain and the vision were growing steadily worse. Family history and past history were unsatisfactory due to language difficulties and the lack of comprehension on the part of the patient, but questioning revealed a typical history of long standing trachoma and numerous associations with that disease since childhood.

General physical examination.—The patient was well developed and nourished, neither cooperative nor intelligent, and presented no significant abnormalities other than her eye condition.

Eye examination.—Vision: O. D. counted fingers at 2 feet, O. S. light projection. The eyes were straight with full excursion but examination was rendered difficult because of severe blepharospasm and photophobia. Both upper lids showed thickening and resultant ptosis with advanced entropion and severe trichiasis. The lashes were wet, matted, and resting on the globes. The palpebral conjunctivas were thickened; scarred, and interspersed with red and unhealthy appearing areas of active trachoma. The cul-de-sacs were partially obliterated by old scar tissue. There was severe lacrimation but no evidence of impaired drainage or infection of the lacrimal apparatus. The cornea showed extensive scarring, irregular heaping up of epithelium, and diffuse vascularization involving the outer third of the corneal thickness. The left cornea was practically opaque and contained several craterlike ulcerations in its lateral quadrant. The pupils could not be satisfactorily examined or visualized.

Laboratory examination.—Kahn test on the blood was 4 plus (yaws), differential blood count showed 16 percent eosinophils with an otherwise normal count. The Weil-Felix agglutination test using OX19 was negative, and the stool contained ascaris ova.

Diagnosis.—Advanced trachoma with complications of bilateral entropion and trichiasis.

Treatment and progress.—Surgical correction of both lids and sulfanilamide therapy were advised, and using the previously described methods corrections were accomplished on the two following days. Vision began to improve immediately following correction and the patient experienced no further pain, photophobia, or lacrimation, after the fourth day. The lid margins were then well everted and the corneal ulcers showed no further staining.

Follow-up.—Examination after 10 weeks showed continued visual improvement. The corneal vascular tissue had changed to a steadily clearing diffuse lacework of scar tissue and the intact pupils were fairly visualized. The lids were pliable, much diminished in thickness, and normal in appearance and position. The conjunctival scarring remained as before, and the palpebral portions continued to show trachoma activity but in diminishing amount. Vision was 20/100 in the right eye and 20/200 in the left. She did not desire, nor did her mode of living require further refractive correction. The patient was entirely symptom-free and had been restored to full economic usefulness. This improvement prevailed at the last examination, 18 months after operation.

¹ Case 1 is an abridgment of a case report submitted to the American Board of Ophthalmology in partial fulfillment of the requirements for its certificate of registration.

CASE 2

History.—P., a 25-year old Samoan woman presented herself for treatment complaining of sore eyes with watering, scratching, photophobia, and impairment of vision, of 3 months' duration. There was a history of continuous association with trachoma patients since childhood, and her history and the findings indicated her own infection to be a long standing affair.

General physical examination.—Essentially normal.

Laboratory findings.—Laboratory studies showed ascaris ova in the stool and latent yaws.

Eye examination.—Vision: O. D.—20/200, O. S.—20/200. Facial expression indicated photophobia and blepharospasm. The lids were thickened and showed well-developed bilateral entropion and trichiasis. The palpebral conjunctivas showed both old scarring and interspersed areas of active trachoma. The corneas were scarred and vascular and contained many subepithelial infiltrations of round cells or trachoma granules in the upper hemispheres. The pupils were normal, the extra ocular muscles intact, and there was no evidence of dysfunction of the lacrimal apparatus.

Treatment and progress.—Bilateral lid correction and sulfanilamide therapy were advised and carried out by the afore-described method. Cosmetic and functional results were entirely satisfactory and examination after fourteen months showed the lids to be fully corrected and normal in appearance and function, the conjunctivas well cicatrized, and no evidence of active trachoma. Vision was 20/50 O. U. uncorrected, and the patient was now entirely free of symptoms.

COMMENTS

One may well question the advisability of early surgical intervention in these cases without some preliminary local treatment. Several factors have prompted this procedure in the management of these cases. It was early found that an attempt to improve the local condition by using copper, silver, or other frequently used drugs, only thwarted the desired end. Pain alone prompted these Samoan patients to submit to surgery. Once their discomfort was even slightly relieved by local medication they would no longer consider surgical correction. It was further observed that a moderate concentration of sulfanilamide in the blood had a far more beneficial effect on the local condition during the operative and postoperative stages than any amount of preoperative local treatment. Nor were any untoward results noted in any of these cases that one might actually attribute to the regimen per se. In fact no complication presented in any case other than an occasionally infected suture, removal of which immediately remedied this. The total absence of this complication would, indeed, be strange under any regimen since the sutures were all passed through a tarsus showing considerable infection. Better postoperative care in such poorly cooperative patients could be more effectively given in a hospital but due to the inconvenience to the natives of such a procedure and their distrust

of such institutions a compromise was necessary in which the patient maintained his ambulant out-patient status.

In favor of the aforementioned operation for correction of entropion the following points may be listed:

1. Simplicity.
2. It is nonmutilating; no tissue is removed and the lid is restored to normal appearance.
3. With proper technic there are few or no recurrences.
4. The correction is directed toward the fundamental defect—the buckled tarsal plate.
5. The operation is equally applicable to both the upper and lower lids.

About the only complication one might encounter is the possible necrosis of the mid-portion of the distal lid-tarsal segment. This possibility can be practically eliminated by giving careful attention to the following points.

1. Leave a sufficiently wide bridge when making the original incision.
2. Omit epinephrine from the procaine injected in this area.
3. Use care in tying the sutures over the splint.
4. Watch for excessive lid swelling during the first day and loosen the sutures if this occurs. (No complications of this type occurred in this series.)

Occasionally in long-standing cases where the stiff, closely clipped, stubby lashes have traumatized the cornea over a long period of time, visual acuity, due to corneal scar tissue, remains unsatisfactory despite lid correction and therapy. After the cornea has been rendered completely avascular such cases may be satisfactorily dealt with by partial corneal resection after the method of Wiener and Alvis (3).

The consistently good results following sulfanilamide therapy in pannus formation and ulceration involving the cornea are both remarkable and gratifying and the smaller stated dosage given over a five-day period seems to accomplish just as beneficial results as larger doses given over longer periods of time. However it must be stated that although improvement practically always follows, rarely do the palpebral portions of the conjunctiva show complete cessation of activity following this type of therapy.

SUMMARY AND CONCLUSION

A method of treating cicatricial entropion by means of surgical correction and adjunct sulfonamide therapy is presented.

From experience gained in treating a series of 70 cases it is believed the following conclusions may be drawn:

1. A modification of the Ewing operation is the operation of choice.
2. Consistently successful results depend upon strict adherence to details in operative technic.

3. Sulfonamide therapy is of inestimable value in achieving satisfactory end results.

4. Sulfanilamide is the drug of choice and its chief benefits are seen in cases involving pannus and ulcerations of the cornea.

Acknowledgment is expressed to Dr. James E. Smith, Government Trachoma Hospital, Rolla, Mo., in whose clinic the writer first saw the technic of the operation described in this paper very kindly and clearly demonstrated.

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FACTORS INFLUENCING SULFONAMIDE EFFECTIVENESS

A number of sulfonamide compounds have been shown to possess a high degree of antibacterial action against many kinds of experimental infections, but because of their behavior and toxicity in man only a few have proved to be of clinical usefulness. It becomes apparent, therefore, that we should select the drug most likely to give the best therapeutic results in a given case of pneumonia. The relative effectiveness of these drugs in the treatment of pneumonia depends largely on three factors, namely: (1) The antibacterial activity of the drug; (2) the ability of the drug to enter into and remain in the circulating blood in effective concentration, and (3) the toxic reactions associated with the use of the drug. On the basis of these factors, it is now generally recognized that sulfadiazine is the drug of choice for the treatment of pneumonia produced by the pneumococcus, streptococcus, staphylococcus, *B. mucosus capsulatus*, *H. influenzae*, and those cases in which there is a mixed infection.—Flippin, H. F.: Causes for unsuccessful sulfonamide therapy of pneumonia. South. M. J. 36: 219, March 1943.



VITAMINS AND DENTAL CARIES

There have been numerous suggestions that feeding of vitamin D and calcium will prevent dental caries. Efforts based on this concept have not resulted in any appreciable reduction in the national caries rate. As a result, certain persons have suggested that recommending vitamins and minerals as caries preventives is an ideal way to ruin a dental practice.—Robinson, H. B. G.: Dental caries and the metabolism of calcium. J. Am. Dent. A. 30: 363, March 1, 1943.

TREATMENT OF PHOTOPHTHALMIA FOLLOWING EXPOSURE TO THE RAYS OF THE WELDING ARC ¹

CLIFTON E. BENSON

Lieutenant Commander (MC) U. S. N. R.

With the increased tempo of industrial activity, aided by a relative as well as a numerical increase in the number of inexperienced trainees in the majority of large industrial establishments, problems of prevention and treatment of injuries and disease peculiar to industry increase proportionately. One such problem is presented by the exposure of the workers' eyes to the radiant energy of the welding arc, with the resultant photophthalmia, actinic ray ophthalmia, or "flash."

This type of eye injury is quite frequent in shipyards and in other industrial plants where welding plays a large part. Exposure of the eyes to the spark caused by short circuiting in a high tension current, and to a carbon arc may also contribute to the total of these injuries. The most common, however, is the photophthalmia following the exposure of the unprotected eye to the welding arc. Strangely enough, it is not the welder himself who is the most frequent victim of his own arc, but the workmen who are engaged in other work near the welder. The latter protects himself with his hood. He may, however, receive an actinic injury from the arc of another welder near him or from his own "accidentally struck" arc while his own hood is raised. This article is concerned primarily with the treatment of injuries of this type and is based upon a series of approximately 3,000 cases of ophthalmia due to actinic rays treated at the Norfolk Navy Yard, Portsmouth, Va.

The pathology of radiant energy injuries to ocular tissues has received considerable attention from various investigators. The welding arc is the source of light of wave lengths from 100 to 100,000 A. U. (3). In accord with Draper's law, it is only the rays which are absorbed that can exert any effect upon the tissues or substance involved (1). Roughly, the media of the eye absorb practically all the infra-red above 15,000 A. U.; between this and 7,000 A. U., increasing amounts are transmitted. Transmission continues high through the visible spectrum until at 4,000 A. U. violet rays begin to be absorbed; a sharp drop in the transmission then takes place until at a wave length of approximately 2,900 A. U., when rays shorter than this are cut off and absorbed by the cornea and conjunctiva (1) (3) (fig. 1.)

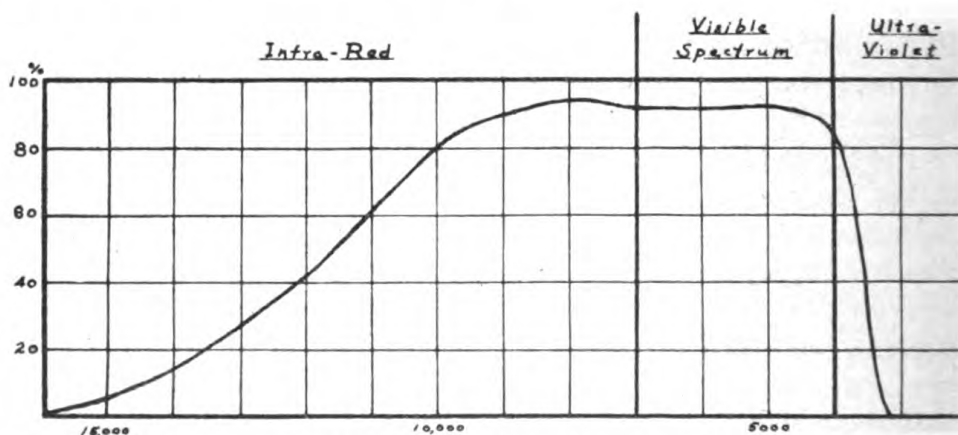
It is generally believed that the short ultraviolet rays are the main offenders in the production of the usual welders' "flash," or industrial

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photophthalmia, but it may be assumed that the longer infra-red or heat rays also contribute.

Duke-Elder (1) differentiates radiant energy lesions into thermal lesions caused by the infra-red rays, and the chemical or abiotic lesions due to the ultraviolet rays of a wave length below 3,000 A. U. In the former class he places "eclipse blindness," radiational cataracts, and the lesions resulting from accidental exposures to the short-circuiting of a high-tension current. Examples of the chemical or abiotic lesions are furnished by ocular injuries following exposure to the arc lamps, welding arc, snow blindness, or overexposure to the sun's rays. The latter type of lesion is characterized by vasodilatation, eosinophilic infiltration, and edema of the conjunctiva. In the cornea, stippling and desquamation of the epithelial cells are described (1) (2).

The symptomatology of the photophthalmia caused by the welders' arc is quite characteristic. After exposure to the arc a latent period



1. TRANSPARENCY OF THE OCULAR MEDIA. THE ORDINATES REPRESENT PERCENTAGE TRANSPARENCY, THE ABSCISSAE WAVE LENGTHS IN ANGSTROM UNITS.

of varying duration ensues. This latent period may vary from 2 to 15 hours, with an average of approximately 8 hours. The lesion then manifests itself with relatively sudden onset of intense photophobia, lacrimation, and a burning sensation in the eyes. The most frequent complaint is that of a feeling of "sand in the eyes." Almost without exception, the lesion is bilateral, although at times the symptoms will appear earlier in one eye than in the other; in the present series of cases the great majority of "one-eyed flashes" were found to be caused by foreign bodies. The most usual history is that the individual carried on his usual work during the day and went home at the end of the shift with no ocular symptoms. Later during the evening the symptoms of burning, lacrimation, and photophobia appeared. Frequently the individual is first aware of the lesion when he awakens during the night with full-blown symptoms. The majority of patients will volunteer the information, "My eyes feel like they're full of sand."

A history of having worked near or with welders can usually be obtained. Apparently a "flash" may result from exposure to rays reflected from a nearby wall as well as from direct exposure.

The appearance of the eyes in a well-developed case is also fairly characteristic. The patient shows photophobia and lacrimation in varying degrees; blepharospasm is at times present. Moderate dilatation of the conjunctival vessels is present, but this congestion is usually limited to the area of the palpebral fissure, giving the appearance of lateral and medial "bands" of vasodilatation. At times the surrounding skin appears erythematous, with mild edema of the lids.

Prevention of eye lesions of this type can be accomplished by protection of the eyes from the offending rays by means of proper shields, hoods and goggles. Inexperience, carelessness and laxity in enforcement of safety precautions play a large part in the production of these injuries. Special vigilance must be exercised during hot weather that goggles are not discarded because of the slight discomfort of wearing them. The minimal safe distance without protection has been estimated as 200 feet (7).

In contrast to the mass of literature dealing with the production and pathology of industrial photophthalmia, comparatively little has been offered along the line of therapy. Home remedies are numerous and varied, and include the instillation of silver protein solutions, various ointments, and poultices composed of substances ranging from tea leaves to sliced raw potatoes. A cursory review of the literature during the past 4 years reveals little with the exception of the use of iced applications, warm applications later, corneal anesthetics, olive oil, and dark glasses (1) (4) (5). Whitehead and Blanton (6) report a series of cases of electric ophthalmia treated by exposure of the affected eyes to an infra-red lamp for 20 minutes, with the eyes open and looking into the lamp; this was preceded by instillation of a local anesthetic.

The problem of dealing with these cases was first approached from the standpoint of symptomatic treatment, consisting essentially of local anesthesia to relieve the discomfort, which at times may be quite intense. It was felt that if the symptoms could be controlled, the worker could be returned to his job with a considerable saving of man-hours. The pathology of these lesions would indicate that the only danger in immediate return to work would be that of a repeated exposure to the ultraviolet rays within 24 hours (1); this can be prevented by keeping the worker away from the vicinity of welders, or the danger minimized to a high degree by protective goggles.

Several of the newer local anesthetics, as ointments and solutions, were used in the eyes. The duration of symptoms appeared to be influenced but little, regardless of the variation in medications; the

severity of symptoms and the discomfort during this period showed considerable variation however. Infra-red therapy, as suggested by Whitehead and Blanton was used on a few cases with results somewhat similar to those obtained with the preliminary anesthetic alone. It was felt, however, that the application of radiant energy therapy to a radiant energy lesion might possibly result in further damage, and results in the author's hands were not deemed sufficiently superior to justify the procedure as a routine treatment.

A series of 520 consecutive cases of ocular radiant energy burns was tabulated as to number of treatments, time lost, and duration of symptoms. With few exceptions, these cases were seen by the author and were all treated under his supervision. No cases complicated by foreign bodies, or of monocular involvement, are included in this series.

Seventy-three cases were treated with butyn sulfate 2 percent (brand of dibutylaminopropyl-p-aminobenzoatesulfate) and diothane hydrochloride 1 percent (brand of piperidinopropanediol diphenylurethane hydrochloride) according to the following routine:

Butyn, one drop in each eye (this was used as a preliminary anesthetic to minimize the burning sensation caused by the diothane).

Diothane, one drop in each eye, repeated every 5 minutes for four instillations.

The treatment was carried out in a semi-darkened room; cool moist compresses were applied to the closed lids during the period of treatment. At the conclusion of the treatment, dark glasses were furnished to the patient.

Four hundred forty-seven cases were treated with a solution containing nupercaine hydrochloride $\frac{1}{4}$ percent (brand of α -butyloxy-cinchonic acid- γ -diethylethylene-diamide hydrochloride) and neosynephrine hydrochloride $\frac{1}{2}$ percent (brand of levo- α -hydroxy- β -methylamino-3-hydroxy ethylbenzene hydrochloride) as the active principals. Butyn was used as a preliminary anesthetic in a small group of these cases, but was discontinued without noticeable loss of effect in order to simplify the routine of treatment. The nupercaine was used because of its relatively prolonged anesthetic action (8). Neosynephrine was added to overcome the vaso-dilatation, and to attempt a partial neutralization of the contraction of the pupils accompanying many of these actinic ray lesions (1). As a result of the latter, the pupils of many of these patients were noted to be dilated temporarily following treatment. The nupercaine-neosynephrine was dissolved in a zephiran 1:5000 (brand of benzyl-trialkonium chloride) aqueous base to decrease the surface tension of the solution for better penetration and to furnish an antiseptic medium. The prescription form of the above solution was:

R₂

Nupercaine hydrochloride.....	0.25
Neosynephrine hydrochloride 1 percent.....	50.00
Zephiran 1:1000 (aqueous).....	20.00
Distilled water q. s. ad.....	100.00

M. et Sig.: "Flash" treatment.

The routine of treatment for this latter group of cases was as follows:

Nupercaine-neosynephrine, one drop in each eye, repeated every 5 minutes for a total of four instillations.

Castor oil, one drop in each eye, 3 minutes after the final instillation of nupercaine-neosynephrine. (The bland oil was used merely as a lubricant or soothing agent.)

The treatment was carried out in a semidarkened room; cool moist compresses were applied to the closed lids during the period of treatment. At the conclusion of treatment, dark glasses were furnished to the patient, to be worn until the cessation of symptoms.

The following results were noted:

TABLE 1.—Comparative results of treatment by butyn and nupercaine

	Butyn- diothane	Nuper- caine- neodyn- ephrine		Butyn- diothane	Nuper- caine- neodyn- ephrine
Total number of cases.....	73	447	Total number of days lost time.....	27	36
Total number of treatments.....	100	651	Average days lost time per case.....	0.34	0.08
Average number of treat- ments per case.....	1.369	1.456	Lost time days per 100 cases.....	36.99	8.05
Number of cases losing time.....	25	36			

All patients were instructed to return the day following each treatment until they were symptom free. An attempt was made to determine the average duration of symptoms by questioning the patients on their first visit as to the probable time of exposure to the welding arc or other source of radiant energy, and again on their last visit as to the time of cessation of symptoms. All patients did not return to the dispensary when free from symptoms, so the time of cessation of their symptoms could not be recorded. Hence the discrepancy in the following tabulation as to the number of patients, compared to the total number of patients treated. It is felt, however, that a rough estimate may be made from these figures:

TABLE 2.—Average duration of symptoms

	Butyn- dio- thane	Nuper- caine- neodyn- ephrine
Number of cases reporting.....	43	191
Average duration (hours) from exposure to end of symptoms.....	46.23	39.04

Since the tabulation of the above series, approximately 2,500 additional cases have been treated, following this nupercaine-neosynephrine routine. An analysis of the last 871 cases shows that in only 18 cases was it deemed necessary by the physician in charge to grant sick leave to the workmen; the majority of this group of cases was seen by physicians other than the author.

From the observation of results in these cases, it would appear that suggested treatment to date has not appreciably decreased the duration of the reparative process, but that symptomatic therapy may return the worker to the job with a considerable decrease of loss in man-hours. From the latter standpoint, it is apparent from table 1 that the treatment has been quite successful. It is of interest to note that in the two tabulated types of therapy, the average number of treatments per case was very nearly the same. During the use of these and other medications, it was the author's impression that approximately the same number of treatments were necessary no matter what the type of medication, although the symptomatic relief, and the ability of the individual to resume his work varied considerably. Neither did the average duration of symptoms, without regard to severity, appear to vary within wide limits. The assumption would be that treatment did not materially influence the speed of tissue repair. Considering the pathology of these lesions, one would hardly expect any specific therapy to increase greatly the rate of healing.

In the cases of welders themselves who received ultraviolet burns of more than slight severity, they are ordinarily advised to take 24 hours' sick leave. It is of interest, however, that several welders who attempted to resume their work after an ultraviolet exposure of moderate severity had been treated with the nupercaine-neosynephrine routine, were able to do so without undue discomfort at the time or later complications. Their eyes were, of course, protected by a welder's hood, and they therefore theoretically received very minimal further exposure to the actinic rays.

Affected individuals other than welders are advised following treatment to be especially careful to avoid reexposure to the welder's arc during the period of symptoms. This period of avoidance of reexposure is of considerable importance; to quote Duke-Elder (1):

* * * the effect of repeated exposures with intermissions is equal to their equivalent as a single long exposure, always provided that the intervals do not exceed 24 hours, beyond which time the factor of physiological repair comes into play.

Theoretically, the application of a local anesthetic to the eye, as practiced in the above treatment, is attended with the danger of symptom-free foreign bodies in the eye, and the accompanying danger of damage to the eye during the period of anesthesia. Fortunately no

such results have been noted in this series of cases, and it is felt that the results of therapy have justified this theoretical danger. This danger may have been counteracted to some extent by the wearing of dark glasses or protective goggles, and to an increased consciousness on the part of the workman to his eyes during this period. To date, also, no permanent ocular lesions due to actinic ray injuries have been noted.

Considerable subjective relief of symptoms has also been noted following treatment of chemical burns of the eye with this routine. Needless to say, this therapy is recommended in such cases only after the usual vigorous irrigation and neutralization of the offending substance has been accomplished.

SUMMARY

A brief resume of the pathology and symptomatology of photophthalmia due to exposure of the unprotected eyes to the rays of the welding arc has been presented.

A type of local therapy used in approximately 3,000 cases of this type of lesion is outlined; this treatment has been found to give considerable symptomatic relief, and to return the affected individuals to their work with a minimum of lost time and no apparent permanent injury.

CONCLUSIONS

1. The reaction of the eye to the rays of the welding arc is photochemical in type.
2. Therapy of the lesion is directed toward symptomatic relief.
3. A method of local therapy is presented.
4. With the suggested therapy, lost time has been minimized, and no permanent injuries have been noted.

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VISUAL RATING, AND PRESENTATION OF AN IMPROVED UNLEARNABLE LETTER CHART¹

JAMES E. LEBENSOHN
Commander (MC) U. S. N. R.

The Navy demands from its personnel a rather high degree of natural vision as well as normal corrected acuity. Due to the exigencies of war the requirements in certain categories have been modified, but only to a limited extent. The present minimum qualifications for uncorrected vision in each eye are shown in table 1.

TABLE 1.—*Navy minimal visual requirements*

Enlisted men—Navy or Marine Corps...	Worse eye, 6/20; best eye 15/20.
Submarine or diving.....	20/20 (11 letters in 4 seconds).
Gun-pointer; coincidence range-finder.	Sighting eye 20/15; other 20/20.
Spotter; stereoscopic range-finder...	20/15; stereopsis.
Naval Academy candidates; aviation cadets.	20/20; no myopia under cycloplegia.
Line officers—Navy or Marine Corps...	18/20; if myopic 20/20.
(DVS) Armed Guard; local defense; communications.	15/20.
Staff officers.....	12/20.
Medical officers.....	12/20 (waiver to 9/20).
Medical officers in diving research...	15/20.
Chaplains.....	12/20 (waiver if below).
Promotion to lieutenant commander...	8/20; best eye 10/20.
Reserve midshipmen—General.....	18/20.
Special branches.....	12/20.
Medical and Dental students.....	12/20.
WAVES (commissioned).....	12/20.
WAVES (enlisted).....	Worse eye, 6/20; best eye 12/20.

The distinctive Navy method of rating vision with /20 as denominator is connected with the use of the Grow (1) unlearnable chart, which contains a series of lines of 20/20 letters. If the eye tested cannot read 20/20, the candidate slowly approaches the chart until an adequate reading is secured. According to the instructions of the Manual of the Medical Department, "slight errors on the part of the applicant, such as misreading a P or T for F, provided the majority of the letters or test characters are read with facility, need not be sufficient cause for rejection." The visual rating in /20 is easily reduced to the decimal gradation with which most ophthalmologists are familiar by

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simply dividing by 2. Table 2 gives the equivalents of the different systems for measuring visual acuity:

TABLE 2.—*Table of visual equivalents*

Snellen notation	Decimal gradation	Navy rating	Snellen notation	Decimal gradation	Navy rating	Snellen notation	Decimal gradation	Navy rating
20/200.....	0.1	2/20	20/50.....	.4	8/20	20/25.....	.8	16/20
20/100.....	.2	4/20	20/40.....	.5	10/20	20/20.....	1.0	20/20
20/70.....	.3	6/20	20/30.....	.6	12/20			

INEXACTNESS OF LETTER TESTS

Because of the intrinsic variability of letters in form and detail the standard Snellen chart is admirably adapted to the needs of the refractionist but for that reason among others is not so suitable as a rating guide. The recognition of letters through a blur is a help rather than a hindrance in refraction in that the attention of the patient is thus held while lenses clarify or dim the image. But the mental factor in interpretation introduces a confusing variable that too often compromises the validity of ratings based on such recognizable symbols. Owing to familiarity, alphabetic characters can be guessed correctly from a few details, and even a sentence may be read without much difficulty when the lower half of the letters are completely hidden. The improvement in uncorrected acuity from so-called eye exercises is to be attributed to education in visual attention, since the methods include nothing more mystic than doing without glasses, encouragement, and perhaps for good measure some training in accommodation, convergence, relaxation, fusion amplitude, or stereopsis. On the other hand impairment of attention adversely affects recognition acuity. A recent experimental study on the immediate effects of heavy drinking showed that in 11 of 50 individuals tested, the acuity fell from 20/20 to less than 10/20 in one or both eyes (2). Emotional disturbances likewise affect visual efficiency, producing a deterioration in some, an improvement in others (3).

The only test objects that precisely conform to the requirements of a visual angle are dots and gaps. In 1870, 8 years after Snellen introduced his charts, Burchardt presented a theoretically acceptable dot test, and among the ingenious charts since devised on scientific principles may be listed those of Wolffberg, Striedenger, Black, Landolt, Ives, and Shepard. The most recent contribution, the Ferree-Rand (4) elaboration of the Landolt circle shows the ring with a double break at right angles. Two such characters can adequately test visual acuity in the four principal meridians. In using their chart I have provided the person examined with an L-shaped indicator, by the turning of which he can definitely signify the direction of the breaks. The test seems well adapted for visual rating where painstaking accu-

racy is essential, as in qualifying men for aviation, gun-pointing, submarine or diving duty.

PINHOLE SIGHTING

The poor vision of ametropia differs from that due to other causes in being fairly correctable by pinhole sighting. When the ametropes looks through an aperture of about 0.75 mm. diameter a rather clear retinal image is formed in accordance with the principle of the pinhole camera. A similar sharpening effect can be produced without the aid of a pinhole disk by narrowing the lids, or with the lids open by turning the head while looking at the chart so that the pupil is sufficiently occluded by the rim of the frame or the bridge of the nose. Irrespective of the chart used the pinhole trick may thus introduce a further complication to the measurement of ametropic visual acuity. In practicing for the visual test some candidates have become so adept in securing the pinhole effect as to register remarkably well without glasses in spite of a considerable refractive error, as the following examples illustrate. In each case the corrected vision was 20/20.

TABLE 3.—*Pinhole sighting*

Unaided vision	Refractive error	Unaided vision	Refractive error
20/20	-1.75 C. x 180.	15/20	-1.75 S.
21/20	-1.50 S./-1.00 C. x 150.	12/20	-4.00 S.
18/20	-2.50 S.	12/20	-75 S./-5.00 C. x 180.
18/20	+50 S./-2.00 C. x 180.	9/20	-5.25 S.
16/20	-2.75 C. x 180.	8/20	-7.00 S./-1.00 C. x 180.

VARIATIONS IN AMETROPIC VISUAL ACUITY

Considering the multiple factors affecting letter recognition it is not so strange that persons corrected to 20/20 by identical prescriptions will vary vastly in their unaided acuity, or vice versa that a wide latitude of ametropia is compatible with the same degree of natural vision. As shown in the summary below an analysis of 1,000 records disclosed that within the same range of refractive error the uncorrected vision would vary unexpectedly from 20/20 to 12/20 or less, with—

Hyperopia	To + 5.00 S.
Myopia	To - 1.00 S.
Hyperopic astigmatism	To + 1.25 C. any axis.
Myopic astigmatism	To - 1.25 C. any axis.

More remarkable still, in the same individual the natural vision may vary in the two eyes, though their refractive error is identical. Which eye will register the better uncorrected vision is unpredictable. From a large series of such cases it could be concluded however, that dominance or nondominance is not the determining factor. In the following table are listed a few examples:

TABLE 4.—*Refraction both eyes identical; natural vision unequal*

[Corrected vision of each eye, 20/20. Italicized type indicates dominant eye]

Natural vision		Correction	Natural vision		Correction
R: /20	L: /20		R: /20	L: /20	
15	9	-.75 S.	17	<i>20</i>	-.75 S.
<i>14</i>	20	+.75 C. x 90.	<i>20</i>	13	-.50 S.
20	14	+.75 C. x 90.	20	16	+1.75 C. x 90.
8	20	+1.75 S./+.50 C. x 90.	8	18	+1.75 S./+.25 C. x 90.

Though the Navy utilizes a standardized method of visual examination, yet the data on the same individual within a few weeks or months not infrequently presents serious discrepancies, such as are cited in the following cases:

TABLE 5.—*Discrepancies in visual reports*

First test		Second test		Refractive correction to 20/20	
R: /20	L: /20	R: /20	L: /20	Right eye	Left eye
16	13	20	17	-.25 C. x 180	-.25 S./-.50 C. x 180.
12	10	18	16	-.75 S./-.50 C. x 180	-1.00 S./-.25 C. x 15.
5	8	12	12	+1.00 C. x 180	-.25 S./+.50 C. x 10.
12	10	17	16	+.25 S./-1.25 C. x 180	-.25 S./-1.00 C. x 90.
7	8	12	12	-.50 S./-.75 C. x 150	-.75 S./-.75 C. x 30.

AN IMPROVED UNLEARNABLE LETTER CHART

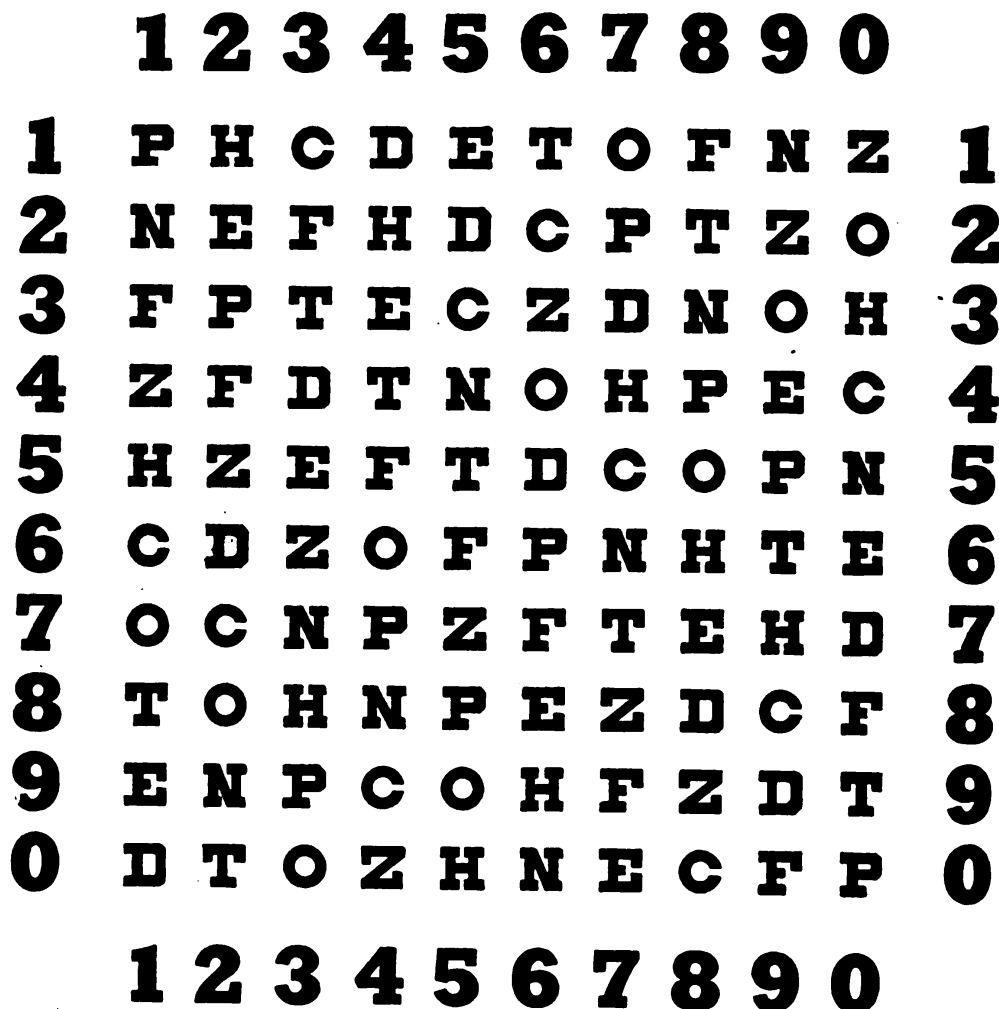
Precision charts with dots or gaps are virtually unlearnable but have gained only a very restricted acceptance. The Ferree-Rand chart was not commercially adapted for projection since their sponsors could not be convinced "that there would be a sufficient volume of sale to meet their standards" (5). Letter charts have a practical appeal in that they need no preliminary explanation and permit simple answers capable of rapid checking. Their popularity continues although ophthalmologists have protested periodically for the past 70 years against their suitability as test characters.

The unlearnable letter chart devised in 1910 by Grow (1), a naval medical officer, has been in official use by the United States Navy since. If the indicated line of 20/20 letters is not discriminated at 20 feet, the applicant slowly approaches the chart until he can respond adequately. An unlearnable letter chart requires this procedure which has the incidental advantage of providing a continuous transition in the size of the letters tested.²

² Objections to this method have been made because the change of distance induces a variation both of accommodation and of size interpretation. Personal experiments as well as those of Bjerke, Landolt, Snell, Hegner, and Brückner indicate that these theoretical considerations are of negligible importance inasmuch as a precise correlation is demonstrable between the visual acuity finding at 20 feet and that as close as 14 inches (8).

In the hope of improving upon the Grow design, a chart of mine is submitted (fig. 1), which differs from that of Grow's in several significant modifications:

1. The letters are serified, as only this style can approximate the Snellen standard of 1-minute detail in both space and line. By adhering to this principle the characters are more likely to become unrecognizable quickly when not seen clearly. The Gothic letters of the Grow chart tend to overestimate



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FIGURE 1.

acuity somewhat so that a rate of 20/20 thereon may not grade as well under the more rigorous requirements of serif letters.

2. Of the letters authoritatively considered acceptable for Snellen presentation the ten that seemed most suitable were selected. Their gradation in difficulty is, according to the sequence determined—

By Jackson (6)----- T C O F P D Z N E H.

By Elschning and Gnad (7)----- C D O T P Z E F N H.

Included are the confusion letters—C, D, O;—T, F, P;—Z, E;—N, H. Dr. W. B. Lancaster of the Dartmouth Eye Institute in a personal conversation suggested

that from the work of Lythgoe the correct reading of 7 of the 10 letters should be considered a satisfactory performance. Among the characters deliberately omitted are L, the easiest of the Snellen letters; and B, the most difficult.

3. Each line horizontally and vertically has these same 10 letters in different arrangements. The four directions in which the chart may be read thus allows 40 possibilities of selection, and whatsoever line is chosen, the visual task is identical. This is certainly not the case with Grow chart now in use, where one line—A E L T Y P H E A L T—is definitely easier than another—O H C D L F N T C O C; and where the letters vertically are often in undesirable arrangements, as in A H C C P O O X L L.

4. For timing the speed of vision as required in examinations for submarine and diving duty, the 10-letter line in this chart is a more logical unit than the 11-letter line in the Grow chart. From a stop watch record of a 10-letter reading the speed per letter in tenths of a second is immediately evident.

5. The lines are numbered—above and below; right and left—to facilitate testing where help is limited and an exposure mechanism, such as that of Grow's, is not available.

6. Instead of conventional cardboard, the format adopted in the Lebensohn (8) Near Vision Chart may be used. With the rugged pyralin-plywood construction the chart has the additional advantages of being stainless, washable and permanent.

FURTHER RECOMMENDATIONS

1. Since the trick of pinhole sighting may vitiate the findings in the determination of ametropic visual acuity, standards of permissible ametropia should be established for the different branches of the service.

2. As a further safeguard the applicant should be required to read the line at the distance that establishes his visual rating within a definite time limit. A standard of one-third second per letter as suggested by Carson and Ebert (9) would seem a fair measure.

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PRACTICAL POINTS IN REFRACTION ¹

ARTHUR ALEXANDER KNAPP

Commander (MC) U. S. N. R.

In ascertaining the index of refraction of a patient, there are many problems. Most of them are well known to the physician, but there are a few basic points which may be of further interest and use.

To ascertain the patient's visual acuity it is not necessary to have twenty feet of testing space. This distance is ideal, but 15, 10, or even 5 feet are sufficient. Although it is unnecessary, a mirror may be used on the far wall when 10 feet or only 5 are available, and a reverse chart is placed on the opposite wall, with the patient facing the mirror, for then the distance of the room is, to all intents and purposes, doubled. Now, if a 15-foot room is used, the 15-foot line becomes the normal, and if 10 feet, the 10-foot line can be the normal. 5/5, 10/10, and 15/15 are all equal to 20/20, practically, since each of these letters on its respective line of the chart, at the distance indicated, subtends the 5-minute visual angle.

The lighting of rooms varies. There are refractionists who prefer a well lighted room and chart. So far as establishing the optimum conditions for the patient's acuity is concerned, it is better to keep the room dark and have only the chart well illuminated. As is known, vision varies directly with the intensity of light, up to the level of glare; above this, vision is reduced. There is no criterion for the threshold of glare; it is a matter of individual variation. Those who suffer from photophobia, or who have a deficiency in either or both vitamins A and/or D₁ may show a low tolerance for light. The majority of persons, however, will reveal greater acuity with a comparatively brightly lighted chart.

Those charts which have a self-contained lighting system or those illuminated by a source close by, do not seem to lend themselves to so fine a discrimination of the letters as does the well focused projection chart. For one thing, when the latter type is used, there is greater contrast between the chart and the surrounding room space, because there is less light diffusion. Often the patient will be seen to squint—a voluntary blepharospasm—to get 20/20, if his vision is defective. Particularly is this true of the myope, who, as a rule, has large pupils. In the presence of a refractive error in an eye with a large pupil, spherical aberration is to be expected. Visual distortion with impaired vision follows—of course depending on the degree of error. The myope, the hyperope, or the astigmatic reduces by squinting the

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size of his pupil, thus cutting out many of the aberrant rays. His vision therefore improves. A practical point may be gleaned from this for those who are obliged to wear glasses for normal sight. If on board ship one finds his glasses broken or misplaced, all that is necessary to do is to cut a piece of cardboard, or some similar opaque material, and puncture its center with a pin. Looking through this pin-point opening, one will be surprised to find that one's vision is approximately normal. This same procedure applies just as well to the person forgetting his glasses for use in the theater.

Another procedure resorted to by the person examined to improve his vision, is a tilting of his head. In the case of the unaided, astigmatic eye, this tilting may improve acuity.

Occasionally it is found that an individual reads 20/20 one day, 17/20 the next, and 14/20 still another; that is, his vision fluctuates appreciably from day to day, or at various times during the same day. He is conscious of these changes. Given a patient with these findings, always suspect the presence of chronic retrobulbar neuritis. Fundus examination, along with the careful plotting of the peripheral fields as well as the blind spots, will rule out or confirm the diagnosis.

For actual, accurate measurement of refraction, cycloplegic drops certainly are superior to the manifest method; i. e., no drops. The use of atropine solution, 1 percent, is the best medication for the purpose. The results obtained with atropine are most reliable, but recourse to the drug has the distinct disadvantage of action for too long a time, 10 to 14 days. Thus, it is impractical. More practical but less reliable substitutes are used. Homatropine solution, 2- to 4-percent, is the most popular. In these days, when it is so expensive and difficult to obtain, it may be supplemented by paredrine hydrobromide, a 1-percent solution. One drop of 4-percent homatropine hydrobromide, followed in 5 minutes by a drop of the paredrine, will give a favorable cycloplegia in 44 to 68 minutes. After examination of the refraction, a drop of 1- or 2-percent pilocarpine hydrochloride solution will hasten the return to the normal pupil, many times in a matter of hours only.

To shorten the time of the lens acceptance, retinoscopy may be employed. In cases of children and illiterates, however, the retinoscopic examination is of primary importance. Admittedly, however, it is accurate within 0.12 or 0.25 of a diopter only.

Reliable cycloplegic acceptance is truly the accurate measure of the person's refraction. Ofttimes, in especially important examinations, the surgeon is hard put to determine the glasses indicated, within a twelfth or even a quarter of a diopter —0.12 plano, or a —0.12 lens. Trivial as this acceptance is, it may still take on great significance. It establishes without doubt the type of refractive error present.

Where myopia is disqualifying for an activity, its presence may change the course of the person's entire future.

It is to be remembered that the fundamental function of the eye is vision. Knowing that that lens which gives the highest degree of acuity is the accurate measure of the eye's refraction, the examiner is well armed. Rather than adherence to constant use of the 20/20 line for the 0.12 diopter finesse, usually it is far better to direct the patient to the 20/15, or even the 20/10 line with the several decisive lenses. He is instructed to concentrate his gaze on one letter. The lens which permits him to read a previously missed letter is the one indicated at the time. When there is a small refractive error, it is surprising how consistent the conscientious patient is in selecting the same 0.12 diopter lens.

For astigmatic refraction the same principle holds true. By concentrating on a small letter, both the strength and the axis of the lens are brought out with comparative ease. When inquiring of the patient with which of the two lenses he sees the more clearly, it is best not only to change the lenses rapidly, but also to keep the lens before the eye for only a brief moment. Too quickly does the macula become "fatigued."

On the other hand, when the examiner is confronted by a malingerer, he is always faced with a potentially exacting situation. No matter how expert the person may be in the art of feigning loss of vision, it is not difficult to ascertain the type of refractive error present, if only the physician will bear in mind that that lens which gives the best vision is the refractive measure of the eye. To be sure, retinoscopy may be corroborative. Insofar as getting the strength of the lens necessary, and the maximum of vision possible in the malingerer, that problem is more difficult of solution. Many well-known tests are at the oculist's disposal, but I might mention one which has given me excellent results. With the polaroid malingering test, it is possible to screen out either eye without touching the patient or his trial frame (it should be stressed that the correct usage must be learned).

Presbyopia, too, presents basic problems. First, it is suggested that when the ophthalmologist is in a quandary as to which of two lenses to prescribe for the addition, it generally will be found that the patient will be more grateful for the weaker one. As far as bifocals are concerned, the time spent on checking their fit will never be regretted, for marked discomfort can be brought on by ill-fitting glasses. To avoid as much prismatic, chromatic, and spherical aberration as possible, it is well to check the visual axis of each eye with the optical center of the segment. Since, as a rule, segments are prescribed for near vision, this checking can be accomplished by holding an uncovered, illuminated ophthalmoscopic bulb before the eyes on the plane of reading. Then as the patient fixes on the light, the pupillary

distance may be measured readily and compared with the pupillary distance of the segments. A practical and quicker method is to have the person, with his lenses adjusted, concentrate on the bulb; then the lining up of the optical centers can be determined by the straight line drawn between the light source and the corneal image.

As a check upon the accurate lens acceptance of the patient, a red-green color test has been popularized. However, somewhat exaggerated and unscientific claims are made for it. A red-green slide is projected onto a screen. The red and green are divided equally in the horizontal meridian; i. e., half red and half green. There are two black, double circles contained within each color. The rationale behind this subjective visual test is, "The red and green filters of the * * * Chart have been so selected (on the basis of their spectral transmission) that, when the eye is focused for yellow, it will be just as hyperopic for red (dioptrically) as it is myopic for green. If, during the test, he (the patient) sees the circles in the red more distinctly—less plus or more minus is required to shift both foci back to the points where they are at equal, opposite distances from the retina. If the circles in the green are seen to be blacker or more distinct, more plus or less minus is required to produce equality."

After the patient's lens acceptance, he is now presumably checked beyond question with the red-green slide. By asking whether the circles on each half of the slide are equally clear and well illuminated, the surgeon will discover the accuracy of the patient's acceptance. If they are equally clear, the correction is perfect. But if, as most often happens, there is a difference on both sides, the patient is in for a little juggling of the lenses. Should the circles in the green be more pronounced, a slight plus addition will even both halves. Now, should the circles in the red be brighter, the signal is for more minus and so on until there is complete uniformity of acuity of the slide. Defective color vision, with its many atypical forms, is not considered.

In an attempt to determine the clinical value of this much-vaunted aid to accuracy in the testing of refraction, I tested 42 eyes of 21 intelligent persons, none of them color blind to any of the 46 American Optical Co.'s "Pseudo-Isochromatic Test Charts." All of them had slight refractive errors. One drop of homatropine hydrobromide, 4 percent, was instilled into each eye every 5 minutes, for six doses. After 20 more minutes with their eyes closed, they were seated facing a projected chart 20 feet away. The rest of the room was darkened. The trial frame was then placed in a secure position taking into account the interpupillary distance, the visual axes, and the space between the lenses and the anterior surface of the corneas. Next, a retinoscopy was performed (unnecessary in these patients). Then they were examined for their lens acceptance. The final measure of their refraction was that lens, or series of lenses, which per-

mitted them the highest degree of visual acuity. Many times the letters on the 20/10 line were employed.

Directly following this lens check, the red-green slide was projected with its contained circles. In some instances, letters were substituted for the circles. The results were similar. (This bichrome slide check-up, it should be mentioned, is also known as the duochrome test.) Of the 42 eyes refracted, 28 insisted on more plus, 9 on more minus, and 5 saw all of the circles or letters equally well. The usual error was 0.25 diopter, though 0.50 diopter's difference occasionally was found.

If the further directions of this duochrome test were to be followed, greater errors would be expected, because under the procedure advised in the paragraph on "The lens correction which gives maximum visual acuity," it is stated that "After the examination of the second eye has been completed, uncover the first eye also and add binocularly all the plus possible, provided that you avoid making the targets blurred or the red targets sharper." From the findings in this experiment it is seen that the majority of persons already have too much plus; i. e., more hyperopia corrected for than really exists. Furthermore, according to the monocular duochrome test, each eye accepted a lens independent of its fellow eye. A number of patients required a plus on one side, a minus on the other, or a plus before one eye, and a plano for the other, etc. Adding more plus binocularly to a previous hyperopic overcorrection will not give maximum visual acuity, but rather will exaggerate the error and give a reduced visual acuity.

CONCLUSION

It may be well to emphasize the point that in the construction of pseudo-scientific instruments, the manufacturer unfortunately, all too often, is overzealous, and apparently not guided by expert advice. Thus we see the uncontrolled, indiscriminate, and misguided advertising of this duochrome test—only one of several important eye-testing accessories or instruments which have been proved (though this has not been completely published) to do more harm than good in the hands of the unsuspecting, gullible tyro. It is urged that manufacturers of basic eye equipment have authoritative boards of medical consultants to advise them on the actual clinical and scientific values of any proposed instruments.

SIMPLE METHODS FOR THE DETECTION OF OCULAR MALINGERING¹

GORDON M. BRUCE

Lieutenant Commander (MC) U. S. N. R.

When an individual is determined to stay out of the service, or to leave it when once inducted, he frequently selects his eyes as a medium for his malingering. He may simulate poor vision or blindness, he may allege that some slight injury has affected his sight, or he may exaggerate a preexisting defect not sufficient in itself to disqualify him for service. We are concerned here only with the methods of revealing good vision in an eye alleged to be faulty.

The detection of ocular malingering is frequently easy when the elaborate apparatus devised for the purpose is available; but the exigencies of the service seldom permit this to be the case. The tests described herein may be carried out with the minimum of equipment by the medical examiner who has not had ophthalmologic training.

It must be remembered that the malingerer seldom alleges complete loss of vision. If he does so, a complete examination of the pupillary reactions must be carefully made. A widely dilated pupil is suggestive of amaurosis; but the possibility of a self-instilled mydriatic must be kept in mind. In doubtful cases observation in the hospital, with a foolproof bandage over the eye, should be carried out. It is possible to encounter blindness in the presence of normal pupillary reaction; but in such cases (in the presence of uremia, for instance), there is almost always sufficient extraocular pathology present to be apparent on physical examination.

In dealing with alleged complete blindness it is advisable to ask the patient to look at his own outstretched hand. A blind person will direct his eyes toward the hand, whereas a malingerer will search for it with wide and exaggerated movements of his eyes. If the patient alleges faulty vision but makes no claim that the eye is blind, he should be asked to read, and a pencil or ruler held before the good eye, as though pointing at the page. If he continued to read without faltering he is reading with the allegedly poor eye.

If possible the examiner should have available a 10° prism, which may be used in several ways, all difficult for the patient to circumvent. For instance, if such a prism be held base in before a seeing eye, that eye will unconsciously turn inward toward the nose. This test is of most value in testing allegedly blind eyes, but may be used to advantage when the vision is said to be faulty. Furthermore, the patient

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should be instructed to keep both eyes open and look at an object across the room. The sharp edge of the prism is then introduced over the pupil of the eye from below. Because this is the good eye the patient will readily admit seeing double. The prism is then moved slowly upward. If the diplopia persists, the patient is seeing with the allegedly bad eye.

If a plus 6.00 spherical lens can possibly be obtained it should be added to the examiner's equipment, because with it one of the simplest and most effective tests can be carried out. The lens is placed over the good eye and the patient instructed to read fine print. Because the lens is over the good eye the patient will do this without hesitation, although he will have to hold the print about 6½ inches from his eyes in order to see well. He does not realize that he is unable to see through this lens beyond that distance, and if he continues to read as the book is moved away he is reading with the other, or uncovered eye.

Many of the so-called bichrome tests entail the use of a stereoscope with a red glass over one eye, and a green glass over the other. There are several disadvantages to such methods. In the first place the shield over the eyes makes it easy for the malingerer to close one eye. This has to be guarded against constantly in all tests, as by this sly maneuver the patient is enabled to detect the deceptions being practiced. As a matter of fact, the surreptitious closing of an eye in the course of the examination is strong evidence of lack of good faith on the part of the examinee. Furthermore, since the apparatus is not always available to the examiner in the service the colored letters on the test card must often be "home-made." In such cases it is difficult to get the colors of the letters to match the colors of the glass so well that they disappear completely when viewed through the filter. If however, the examiner has a red glass of approximately the same shade as a 2-cent stamp he should place the glass over the good eye and direct the patient to look at a 2-cent and a 1-cent stamp placed on a plain dark background. If the patient sees a green stamp he is seeing with the allegedly poor eye. An alternative method is to have him write with a red pencil while a red glass of the same shade is held over the good eye. If the other eye really sees poorly he will have difficulty in doing this.

A simple test which sometimes is of value consists of putting a disk perforated by a pinhole before the good eye and asking the patient to read. His head is then tilted backward or the disk is raised somewhat, and if he continues to read he is reading with the uncovered eye.

Finally, it must always be remembered that the patient may really have a visual defect, and so a thorough examination and history are necessary. Above all, it must be emphasized that a sympathetic and

disarming approach will often result in eliciting a frank admission of malingering after a few of the tests have been made and the patient told without rancor that he has failed to make a case for himself. This he will seldom admit if the examiner is harsh. Difficult or doubtful cases are probably best referred to the ophthalmologist, but few malingerers can evade the simple traps described above.



SHOCK FROM CHEST INJURIES

Shock arising from chest injuries has some peculiar features which tend to make its degree more profound and the treatment of it more difficult. The oxygenation of the blood may be seriously affected by compression of, or injury to, the lungs. The circulation of the blood itself may be rendered difficult by abnormal changes in the intrathoracic pressures, and on occasions by embarrassment of the heart itself. Hemorrhage in chest injuries is often severe and not easily controlled, and gives rise to a serious reduction of the blood volume. The effect of this supervening on the true shock syndrome produces a profound circulatory collapse.—Davies, H. M., and Coope, R.: Shock. War Injuries of the Chest. 40-45, 1942. The Williams and Wilkins Company, Baltimore, Maryland.



MARCH FRACTURE

Because of the fact that the true nature of March fracture has not been generally known in the past, serious mistakes have been made in diagnosis and treatment.

The condition has been described in people of both sexes and in different walks of life. Pain in the foot follows much walking or weight bearing. There is accompanying swelling and tenderness. Roentgen rays may, or may not, show evidence of a fracture of the metatarsal shafts. The second metatarsal is usually involved, but all of the others may, at times, be implicated.

Many forms of treatment have been advocated, the most common being rest in a plaster cast.—Swart, H. A.; March fracture as a complication of pregnancy. Am. J. Surg., 59: 602-604, March 1943.



Dermatophytids can be treated properly only if the primary focus is entirely eradicated. Sometimes this is difficult, so in addition to the local treatment of the dermatophytosis the so-called desensitization therapy must be attempted.—Peck, S. M., and Schwartz, L.: A practical plan for the treatment of superficial fungus infections. Pub. Health Rep. 58: 337-345, February 26, 1943.

METHOD OF GROWING THE RAT TOOTH GERM IN VITRO USING THE DEPRESSION SLIDE

FRED L. LOSEE

Lieutenant, junior grade (DC) U. S. N.

The primary object of this experimental work conducted in the division of operative dentistry at the University of California, was to investigate the primary centers of lobular development of the tooth; to delineate, if possible, the origin and significance of the primary and secondary grooves, and to establish the possible relationship of pit and fissure cavities to the failure of lobules of enamel to become unified.

Three groups of investigators have used homogenous methods of planting dental tissues:

Legros and Magitot (1874) (2) removed tooth germs from dogs 21 to 28 hours after birth and grafted them subcutaneously in guinea-pigs and adult dogs. Their work was handicapped by the lack of an aseptic technic, but even so they were able to show self-differentiation of the teeth that did survive.

Huggins, McCarrol and Dahlberg (1934) (3) grafted cuspid teeth of dogs between the ages of 3 to 6 weeks onto the connective tissue of the abdominal wall or thigh of the same dogs. They showed that dental tissues have the power of self-differentiation.

William E. Hahn (1941) (4) grafted the 6-weeks' old cuspid teeth of female dogs to the ovaries or to the abdominal wall of the same animals and furnished proof for the self-differentiation of the dental tissue, as did the previous investigators.

For our purpose these methods of growing teeth did not allow constant observation and isolation of the tooth germ in a controlled environment. We rechecked Fell and Robison's (1934) (1) method of growing the femur in a watch glass, and the work of Glasstone, of England, (1935) (5) who worked at the Cambridge laboratories.

Glasstone in her investigation used the tooth germs of from 18- to 21-day rat embryos in vitro. Her observations showed that odontoblast formation could be watched, but degeneration started at from 14 to 20 days in vitro. A further finding was that 20-day dentin formation in vitro was the same as 4 day in vivo. She proved that embryonic dental tissue was differentiated normally when isolated from the blood supply, nervous system attachment and surrounding bone, and cultivated in vitro. It was here that our work started.

One of the first serious problems encountered involved aseptic dissection of the tooth germs. With the cooperation and under the super-

vision of Dr. John B. deC. M. Saunders, and after a great many methods had been tried, we finally standardized our dissecting technic.

Over the past 2 years, we have tried various materials, ranging from 20-day embryonic mice teeth and 18-day embryonic tooth germ of the rat to the 4-day second molar of the rat. We found the best results as regards asepsis with the 20- to 21-day embryonic rat first molars. At this age calcification has not started and intrauterine asepsis is present. We now use the 20- to 21-day embryonic upper first molar Norwegian rat tooth germs as a standard. This rat family is one developed by Dr. Long, of the University of California.

Our surgical procedure starts with the taking of vaginal smears of the rats, and when we have determined pregnancy to be of 20 to 21 days' duration, we prepare the animal for a cesarean operation. The field is sterilized and the embryo rats are removed aseptically and placed in sterile Petri dishes. A dissecting scope is prepared with a dissecting plate (cork pad covered with a sterile cloth). The 20-day old embryonic rat is handled with sterile tweezers and the scalpel is used to sever the mandible and main body from the top portion of the head. This gives a clear field of vision of the palate, ridges and buccal folds, with no interference. The severed head is held in place by inserting a sterile pin on each side in the buccal fold to hold the buccal tissue away from the field of operation. Using an iridectomy knife, we peel back the mucous membrane of the palate, crest and buccal plate, thus exposing the bone. Since at this age the bone along the crest of the ridge is unfused, we can insert the knife and push the buccal plate of the maxilla laterally. Next we remove the palatal bone by forcing the bone medially from the tip of the crest, thereby exposing the tooth germ. A cataract knife can then be slipped under to elevate the tooth germ slightly, and the lingual attachment of the dental lamina can be severed before complete removal. At this point the first and second molar teeth may remain attached or may be separated. In this stage the second molar is a very small round mass of soft jellylike structure.

The tooth germ is immediately planted in the prepared medium. Glasstone and Fell both wash their plants in a saline solution or glucosol at this point, but after finding no difference in the end results from washing plants we have eliminated this step. Carrell (6) used for his cultures long necked flasks which allowed better observation. The long neck complicated our transplanting.

Fell and Robison, as well as Glasstone, used a watch glass in a Petri dish, with moist, saturated cotton around the watch glass. We discarded this technic because of the extra glassware that was required and the possibility that the watch glass might slide around or tip. The watch glass was also too deep to be placed under the microscope. Their second method, the hanging drop, was the best for observation, but here we felt that the proportion of medium to tissue was not great

enough, considering as well the added time required to get a good hanging drop.

A pooling of ideas resulted in the use of a hollow-ground slide, the hollowed out portion of which was used as a dish. The plant was sealed by placing a cover slip over the depression and paraffining the edges to the slide. This depression allowed the use of 6 drops of medium, whereas the hanging drop method allowed only 2 drops to be used. This method gave us a combination of speed in planting, more medium than the hanging drop method and good observable growth.

Just before planting we took the hollow-ground slides and embryonic extract and plasma and placed them in the incubator in order to have a planting temperature around 38° C. This cushioned the shock of planting for the tooth germ.

When the material was ready the animals were prepared and the hollow-ground slides were placed under a Petri dish cover. Into the depression slide 3 drops or 0.15 ml. of extract was pipetted. The tooth germ on removal was immediately placed in the extract, and 3 drops, or 0.15 ml., of plasma was added. A cover slip was paraffined over the depression either before or after clotting took place, and thus the depression was sealed from any external contaminating possibilities. To aid in any further observation a protocol was kept on each slide as to time, age of extract, age of plasma, and unusual conditions present when planted. The slide as soon as it was sealed was placed in an incubator operating at an unvarying temperature of 38.5° C.

The plant should be planted every 48 hours, but, owing to a full schedule, our transplants varied within 48 to 72 hours.

In transplanting, the preparations remained the same as for the foregoing, with the omission of the surgical procedure on an animal. The tooth germ was lifted out of its old medium into the new extract. If at this step a bit of the old medium clung to the tooth germ, it was washed off in a Tyrode's solution which had a temperature of 38° C., before being placed in the new extract. The final step in the transplanting was as before.

Now that we could obtain our material aseptically, we needed a nutrient for it that was also aseptic. For blood plasma we used the blood of Flemish giant rabbits which were bled for 50 ml. every 2 weeks.

The rabbit was tied to a board and shaved over the heart. The shaved area was painted with iodine, then washed with alcohol. To rabbits that were new to the procedure we gave ether anesthesia. (After a few times on the board, the animal is rather passive and anesthesia is unnecessary.) Previous to the insertion of the 18-gage 2¼-inch needle on a 50 ml. Luer syringe, we drew in 5 ml. of heparin to prevent coagulation. After withdrawal of the 50 ml. of blood

from the heart itself, the syringe was rotated to mix the blood and heparin. This mixture was then placed in chilled centrifuge tubes and centrifuged at 4,000 r. p. m. for from 10 to 15 minutes, 4,000 r. p. m. being attained in a period of 5 minutes. The plasma was decanted into the chilled paraffined tubes and placed in the icebox. This plasma has a useful life of 7 to 10 days.

Heparin is prepared by dissolving 1 mg. to 100 ml. of a physiologic sodium chloride solution, then autoclaving for sterilization. Sterile rubber vaccine plug caps are placed on the bottles of heparin, which are then kept in an icebox. Heparin has a useful life of around 60 days.

Embryonic extract is obtained from 7- to 10-day chicken embryos. These are removed from the egg aseptically and placed in a gridder which forces the embryonic tissue through minute holes, thus giving a juicy pulp. This pulp is then placed in a centrifuge tube, 1.5 ml. of pulp tissue in each tube, and to this for the first part of our investigation we added 5 ml. of glucosol instead of the Tyrode's solution.

The mixture of embryonic tissue and Tyrode's solution is thoroughly shaken in the centrifuge tubes, then stoppered by sterile corks and allowed to stand for one hour. Then the mixture is centrifuged at 4,000 r. p. m. for 15 minutes. The decanted fluid, or extract, is poured into a standard test tube stoppered with a sterile cotton plug and is placed in a freezing compartment, where it is frozen. It is removed to room temperature till it thaws out and then is replaced in the freezing compartment to freeze again. This time it is placed in the lower part of the icebox to retard the thawing process. This step aids in cellular destruction. The useful life of this extract is 7 to 10 days.

Tyrode's solution is made up as follows:

	<i>Grams</i>
Sodium chloride.....	8.00
Potassium chloride.....	.20
Calcium chloride.....	.20
Magnesium chloride.....	.10
Sodium acid phosphate.....	.05
Sodium bicarbonate.....	1.00
Glucose.....	1.00

Water (triple glass distilled) to make 1,000 cc.

The pH of the Tyrode's solution should range from 7.4 to 7.8 if it is made correctly and pure reagent salts are used. The completed mixture is sterilized immediately by passage through a Berkefeld or Seitz filter. It is then placed in rubber-stoppered pyrex tubes and stored in the refrigerator.

Tyrode's solution with 3x glucose is effective where large quantities of tissue are being cultivated in a small volume of medium. The amount of glucose is increased to 3 gm. and the sodium chloride should be reduced to 7.78 gm., in order to give an isotonic solution.

Glucosol, a modified Tyrode's solution, has been used in Carrel's laboratory for many years. It has the same composition as Tyrode's solution except that the sodium bicarbonate is omitted. It is slightly acid in reaction and has almost no buffering action. It takes on the pH of the material with which it is mixed and can be sterilized by heating in boiling water or by autoclaving.

This solution was used in a series of experiments to try to get growth, as its ease of sterilizing as well as of storing is a definite advantage if the same growth was obtained as with Tyrode's solution.

Many of our failures at the beginning, in spite of the sterility of all plants and media, were traced to the following:

1. An unreliable incubator where temperature varied either at different times or locations within itself. A lightproof incubator with circulating warmth is preferable. Any variation in temperature affects the thermal sensitive ameloblast and, if severe enough, may affect the entire germ.
2. Traumatic handling of the tooth germ at the time of dissection or planting. This is very easy, because the tooth germ is very soft at this stage.
3. Glassware that was not chemically clean and bacteria free. New glassware should be treated the same as old glassware before using.
4. Extended periods of observation on the stage of the scope, which allow the medium and tooth germ to cool, affecting the thermal sensitive ameloblast.
5. Exposure of the tooth germ to any radioactive radiation or sunlight.
6. Use of an inferior breed of rat. This can cause a change, but development of a controlled group of animals can offset this change or eliminate any chance of a change.

Many questions are still to be answered and ideas worked on. The following suggestions are made with the hope of stimulating workers to think along these lines and leading others interested to answer them:

1. Check the different effect of growing the tooth germ in the clot as against growing it on the clot as Fell did with his femurs.
2. Develop new media or ways of concentrating media in order to speed growth. We now take 5 days in vitro to do what can be done in 1 day in vivo.
3. Run a series of plants observing differences in the rate of growth on Tyrode's solution with 3x glucosol and glucosol with 3x glucose.
4. Try planting and growing the tooth germ in a modified Lindbergh heart solution using a fluid medium instead of the clot.
5. (a) Experiment with means of administering the various vitamins in excess in the medium in such a state as to be used by the tooth germ. For example irradiate the plasma or extract with ultraviolet rays so as to activate it to vitamin D formation. (b) Add irradiated milk for the increase of vitamin D.
6. Study actions caused by the use of different plasmas, such as the plasma of the rat, chicken, rabbit and human being.
7. Develop better methods for handling the tooth germ.

RESULTS

The tooth germ has been kept alive for 78 days in vitro, the experiment being stopped only because of the ending of the college year. During the 78 days a standardized procedure was not used exclusively;

many variations in technic were included. Therefore, better, faster growth is expected with the use of the described technic exclusively.

At the time of fixation, 95 percent of the tooth germ was still vital. Normal differentiation of tooth tissues has proceeded with complete morphogenesis.

In this report, we can definitely say that tooth germ growth in vitro is positive, but the limit to the growth is not known. A perfected dental tissue culture technic would provide an ideal method of studying physiologic problems in tooth development, as well as suggesting a means of investigating primary centers of lobular development. To date we believe that the technic described is the one best suited for dental tissue culture.

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SULFONAMIDE SELECTIVITY

Experience with the sulfonamides in the treatment of various forms of pneumonia has indicated that their therapeutic effectiveness depends largely upon the infecting organism. If the infection is produced by the pneumococcus, streptococcus, staphylococcus, or possibly the *B. mucosus capsulatus*, and the *H. influenzae* one should expect satisfactory results with these drugs. However, if the pneumonia is not caused by one or another of these micro-organisms, there is little reason to hope for success with this form of treatment. Hence, it is expedient that the causative agent of each case of pneumonia be determined, although this does not mean that chemotherapy should be withheld until a bacteriologic diagnosis has been made, as the clinical diagnosis of pneumonia constitutes ample indication for the prompt use of the drug.—Flippin, H. F.: Causes for unsuccessful sulfonamide therapy of pneumonia. *South, M. J.* 36: 219, March 1943.

MINOR PATHOLOGIC CONDITIONS OF THE FOOT IN NAVY PERSONNEL ¹

VICTOR H. WITTEN

Lieutenant, junior grade (MC) U. S. N. R.

and

MORRIS LEIDER

Lieutenant (MC) U. S. N. R.

In the practice of military medicine there is a constant tendency on the part of the personnel to disregard, or regard with contempt, minor pathologic conditions in general. The reasons for this seem to be that the military group is young and vigorous, that an unusual physical and mental toughness is called for in this day, and that under combat most of the conditions seen are of major dimensions.

Several mistaken corollaries, however, are drawn from these circumstances. One such is that ruggedness is induced by taking lightly minor pathologic conditions. It is more likely, however, that a raggedness is caused by such practice. Fortitude and stamina in bearing injury and disease are desirable and necessary. These qualities can be inculcated psychologically in a healthy body by methods that build morale and they are enhanced by the hardening of graded exercises and drills. But medically it would seem erroneous to think that chronic or repeated suffering of minor pathology fosters resistance or obliviousness to it. There is also a common misconception that chronic, low grade suffering induces an immunity to itself. Many persons boast of quick healing powers and rashly invite or neglect minor cuts, bruises and infection in their proud certainty that they will easily and always conquer pathogens. Again it is more likely that the power to heal and to withstand wounds and other disabilities is promoted by prompt attention when incurred and by avoiding needless repetition.

We believe that the total loss of military efficiency that results from a summation of small suffering is not inconsiderable. In total war every bit counts, and we believe that this fraction of loss can be reduced, particularly with regard to minor disabilities of the foot.

This paper is written from a dispensary experience with a conglomerate of Navy personnel consisting of the usual categories of enlisted men, officers, aviation cadets (British and American) and marines. The study was undertaken during one of the warm and humid months that are common in the geographic zone of the Gulf Coast. In this 30-day period a total of 4,816 visits were recorded in the dispensary log. Of this number 840 or 17.6 percent of visits were for complaints referable to the feet.

¹ Received for publication December 14, 1942.

Of the 840 visits for foot complaints, the enlisted personnel composing 63 percent of the station complement contributed 57.7 percent; commissioned officers composing 25 percent of the complement contributed 4.6 percent; and cadets composing 12 percent of the complement contributed 37.7 percent (figs. 1 and 1a). By etiology, the classification of visits becomes: 65 percent for "athlete's foot", 10.6 percent for mechanical injury, 8.0 percent for ingrown toenails; 6.9 percent for cuts and abrasions, 6.9 percent for blisters and 2.6 percent for corns, callosities and plantar warts (fig. 2). Finally, these data are graphically charted in figure 3 by percentage of each category of disability.

In the course of this study the following clinical observations were made:

1. Any dermatosis of the foot is "athlete's foot" to the patients and too frequently to the medical officer. A resolution of etiology as to fungous, pyodermic,

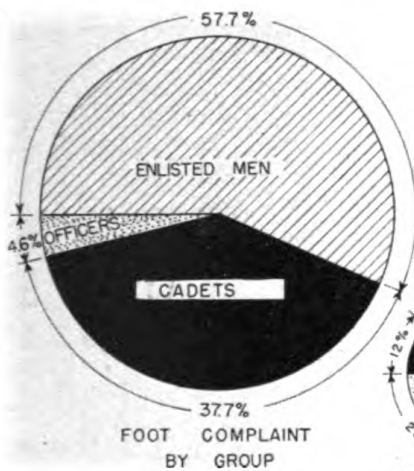


FIG. 1.

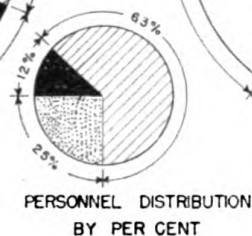


FIG. 1a.



FIG. 2.

allergic or other cause is desirable although proper treatment may frequently be applied from the clinical appearance alone (see outline below).

2. Practically all the complaints of ingrown toenails, corns, callosities, and blisters had their onset after the individual joined the service. The same was true of mechanical injuries like "sore feet," sprained ankles, and miscellaneous traumata. In such cases the shoes were found to be too short, too narrow, or both. Blisters and corns usually developed while shoes were new and in process of being "broken in" and again when shoes became old, worn and wrinkled in lining. Ingrown toenails were noted to develop 3 weeks to 3 months after ill-fitting, general-issue footgear was worn.

3. The majority of minor pathologic foot conditions were seen to occur principally among enlisted personnel and cadets. Reasons for this are easy to find in such facts as both groups wearing shoes of the same nature, the lack of painstaking care in fitting general-issue footgear, and the same rigorous schedule of marching, drilling, and continuous activity.

The principles of foot hygiene seem simple and obvious but are often neglected, repeating because so little attention is paid to them. We have the impression that if an amount of attention equal to that given to the teeth were accorded the feet, an equally great, if not greater, benefit would accrue. The simple practice of daily washing of feet followed by meticulous drying and dusting with an i

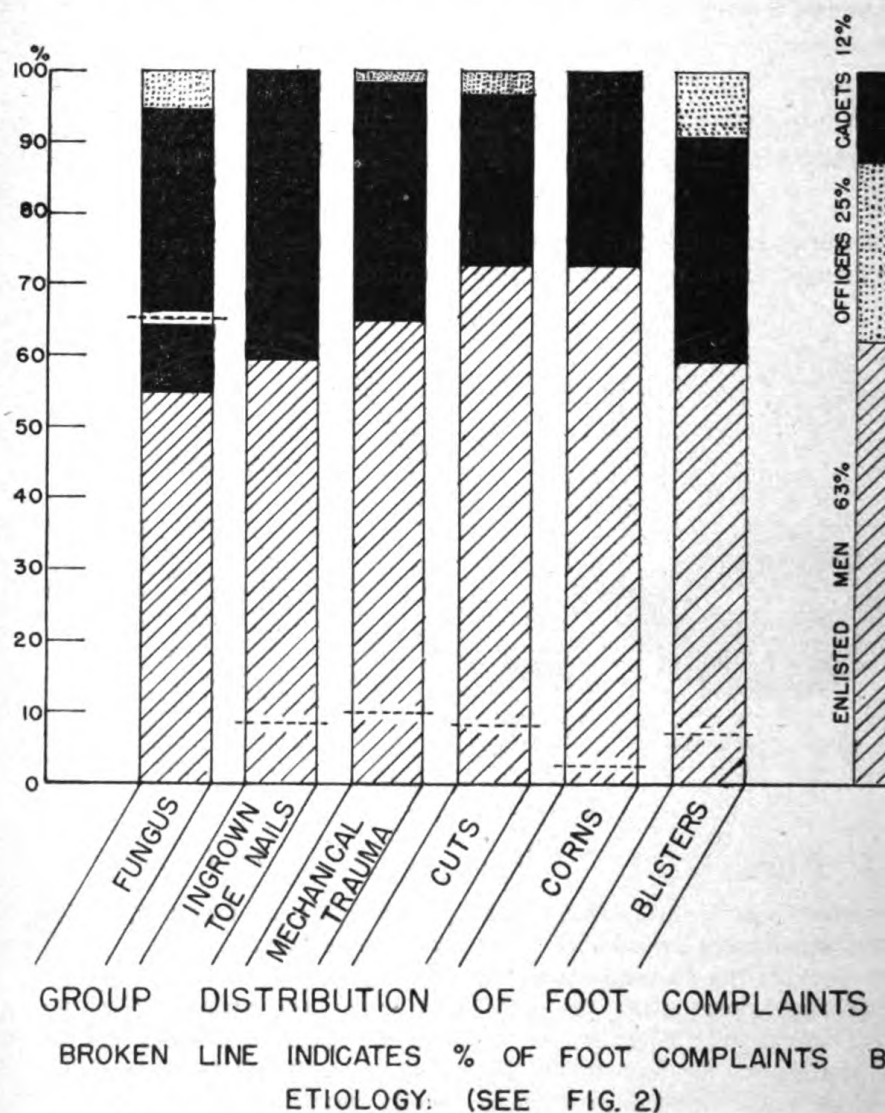


FIG. 3

sive absorbent such as powdered chalk, would eliminate the amount of fungous and pyodermic infections. A care in footgear, both shoes and socks, eliminating friction, pressure, mechanical imbalances, would prevent corns, callosities and minor orthopedic defects. A small expenditure in time and money to indoctrinate personnel with these desiderata would repa

many times in less time lost from duty, more efficient performance of tasks and better general locomotion.

The therapy of the common disorders of the foot, prophylaxis and treatment, may be outlined as follows:

I. Infections: Fungous and Pyodermic:

A. General principles:

1. Not every infection of the foot is "athlete's foot."
2. Fungous infections of the foot are not all identical in etiology or morphology, and therefore are not amenable to a solitary, stereotyped prescription.
3. In general, the more severe the infection, the milder should be the local treatment.

B. Acute infections:

1. Rest of the part.
2. Hot, wet dressing with, e. g., aqueous solution of potassium permanganate (1:6000) or Burow's solution (1:20) or aqueous solution of boric acid (saturated).
3. Pyodermic processes may be expected to subside with these aids to the body defense. Localizing staphylococcal infections may require incision and drainage. Streptococcal infections may require sulfachemotherapy.
4. Fungous infections, acute and secondarily infected, will usually be brought to a certain degree of improvement with rest and wet dressings. From this point on a variation in dermatologic therapy according to the site and character of the dermatosis is usually necessary.

C. Chronic infections, usually fungous:

1. Topical remedies, e. g., keratolytics and fungicides: Salicylic acid, benzoic acid, resorcin, sulphur, ammoniated mercury, gentian violet, thymol iodide, camphor, phenol, etc. A judicious combination of these agents and their preparation as ointments or lotions is important in the end result.
2. X-ray therapy, for resistant, eczematous forms.

D. Prevention of recurrence:

1. Local cleanliness and dryness.
2. Antiseptic absorbent powders.

II. Corns, callosities, and ingrown toenails:

A. Prevention:

1. Removal of friction and pressure.

B. Miscellaneous methods:

1. Caustics and keratolytics such as bichloroacetic acid, 25 percent, salicylic acid in collodion or as a plaster.
2. Physiotherapy: X-ray.
3. Surgery: Excision, paring, dessication.

III. Plantar Warts:

A. Miscellaneous methods:

1. Removal of friction and pressure.
2. Surgical extirpation by scalpel or electrodessication.
3. X-ray therapy.
4. Psychotherapy.

IV. Hyperidrosis:**A. Local measures:**

1. Physical cleanliness.
2. Anhydrotics, e. g., 25 percent aqueous solution of aluminum chloride powders.

V. Orthopedic defects:

- A. Proper foot gear.
- B. Special orthopedic devices.

SUMMARY AND CONCLUSIONS

Enlisted men and cadets made a disproportionately greater number of visits for foot complaints compared to officers. The reasons seem to be:

1. They wear shoes of similar nature which are general issue and may not be properly fitted.
2. These categories do a great amount of marching and drilling.
3. By their schedules of activity they are more subject to minor injury and are more likely to neglect incipient infection. Delay in reporting for treatment and self-treatment were common.

Officers suffer relatively little from minor pathology of the foot for the reasons that:

1. They buy shoes of their own choice and are more careful of fit.
2. They can and do practice better foot hygiene.

In general, the hygiene of the foot is neglected. The principles should be taught in a program of preventive medicine.

**SUCCESSFUL SULFADIAZINE THERAPY**

To obtain maximum therapeutic results with sulfadiazine in the treatment of pneumonia, it is necessary to administer the drug in such a manner as to attain effective concentration of the drug in the circulating blood as soon as possible, and to maintain it until the patient has developed sufficient immunity against the infection to prevent a relapse. Failure to obtain an adequate concentration of the drug in the blood naturally leads to unsuccessful sulfonamide therapy. Flippin, H. F.: Causes for unsuccessful sulfonamide therapy of pneumonia. *South. M. J.* 36: 220, March 1943.

**CALCIUM OF THE BODY**

The average person has from 1,400 to 2,000 gm. of calcium in the body, 12 gm. of this being in the permanent dentition.—Robinson, H. B. G.: Dental caries and the metabolism of calcium. *J. Am. Dent. A.* 30: 364-365, March 1, 1943.

HYPERVENTILATION AND HYPERVENTILATION SYNDROME ¹

ROBERT W. QUINN
Lieutenant (MC) U. S. N. R.

Hyperventilation has been known and observed for many centuries and although the reasons for it were not known nor were the symptoms of the sufferers correctly attributed to hyperventilation, invariably it has been associated with some momentous emotional disturbance.

An increase in the quantity (minute volume) as a result of the increase in rate or depth or both of respiration is known as hyperventilation or hyperpnea. There are numerous causes of hyperventilation, e. g., muscular exercise, anoxemia, hot baths, hyperthermia, sudden pain, and sensory stimulation such as the sudden application of heat or cold to the skin. Hyperventilation may be considered as one the manifestations of anxiety or fear but there are certain signs and symptoms which are a direct result of hyperventilation itself. In milder forms the symptoms and signs are extremely variable but severe hyperventilation can be carried on to such an extent as to produce a definite symptom-complex known as hyperventilation tetany.

It has not been long since the symptoms attending anxiety states or neuroses were attributed to the patient's imagination or interpreted as an attempt on the patient's part to gain attention. It is now known that the symptoms of a person suffering from anxiety or fear or a neurosis are just as real as those due to an organic disease. The general symptomatology of anxiety states and neuroses has been described as vague. If these complaints are carefully investigated it will be seen that they are not vague but represent actual subjective sensations which in many cases could not be described any more accurately by the physician.

Some of the physiological and biochemical changes accompanying hyperventilation are known, but the mechanisms responsible for the production of symptoms are complicated and controversial. The same is true of the anxiety states and neuroses.

Many of the symptoms of anxiety states are directly due to hyperventilation and the physiological and biochemical changes produced by hyperventilation. The following symptoms which are often puzzling to the physician commonly accompany hyperventilation:

1. Weakness and excessive fatigability.
2. Dizziness and blurred vision.

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3. Nausea and vomiting.
4. Palpitation.
5. Muscle cramps and muscle tightness.
6. Air hunger or shortness of breath.
7. Sweating of the hands.
8. Diarrhea or constipation.
9. Numbness and paresthesias.
10. Urinary frequency.
11. Precordial pain.
12. Epigastric pain.
13. Lower abdominal cramps.

The symptoms presented by each patient of course vary both in severity and character from day to day. In a group of 50 patients admitted to the University of California Hospital classed as psychoneurotic, nearly 70 percent were found to have symptoms associated with hyperventilation similar to those listed above.

If otherwise normal persons are hyperventilated, these same symptoms appear in varying time intervals (5). If hyperventilation is persisted in, a definite syndrome known as hyperventilation tetany appears. The tetany may vary from slight stiffness of the fingers resulting in clumsy movements of the hands, to severe carpopedal spasm and tetany of certain facial muscles. The latter may give rise to changes of facial expression characteristic of persons suffering from acute anxiety. Chvostek's and Trousseau's signs may be demonstrated at this time. Severe cramps in the abdominal and leg muscles occur in some individuals. Movement becomes difficult and many individuals are able to move only very slowly and with great pain. Other changes may occur at this time, including tachycardia at rates up to 140 to 150 per minute, hyperidrosis, decrease in the skin temperature of the extremities, numbness and tingling about the hands, feet, and face even to the point where the patient cannot feel his hands or feet, clouding of the sensorium, and finally unconsciousness.

The symptom-complexes presented by these patients may simulate organic disease very closely, so closely that these patients often are referred to an internist when the accepted methods of treatment of the suspected organic disease fail. In a study by Kerr et al. (1), protocols of examples of several types of anxiety states are presented which are typical of this group of ailments. Listing these groups will help in the understanding of these patients. They are as follows:

1. Tetany.
2. Evidence of generalized muscular irritability without actual tetany.
3. Severe convulsive state simulating grand mal.
4. Localized spasms of muscles with symptoms simulating those of cardiovascular disease.
5. Vascular disturbances: Pseudo Raynaud's disease.
6. Disturbances simulating diseases of the chest mainly of the asthmatic type.

7. Simulation of thyrotoxicosis.
8. Pseudo Ménière's syndrome.
9. Organic disease (coronary occlusion) producing hyperventilation tetany as a symptom.
10. Suspected neuroses which were not proved by hyperventilation experiment.

Soley and Shock (2) concluded after their study that "the respiratory alkalosis resulting from hyperventilation produces the symptoms of effort syndrome." There is a great deal of controversy on this subject and Jones and Lewis (11) agree in a general way that effort syndrome is largely a mental disorder. Wood (12) states that:

The total evidence indicates that hyperventilation cannot be held responsible for the symptoms and signs of Da Costa's syndrome, neither by causing tissue alkalosis nor by interfering with the circulation; but apart from rare organic causes, merely one mechanism by which psychosomatic manifestations are produced. * * * It is commonest in the hysteric.

It is not known if hyperventilation occurring frequently over long periods of time will produce permanent organic changes or irreversible functional changes, but it is true that organic changes can occur in individuals who suffer from anxiety states or neuroses over a period of years. Examples are emphysema, occurring in individuals who have chronic asthma on a psychogenic basis, or malnutrition and vitamin deficiency states in persons with anorexia nervosa. Functional changes accompanying anxiety have been thought to contribute toward the production of peptic ulcer. Continuing the same line of thought, physicians have often wondered at what stage neurosis leaves off and psychosis begins. Russel (4) aptly puts it by stating that "the dividing line between physiological and psychological is sometimes difficult to draw."

More and more it is being realized the important part hyperventilation plays in producing symptoms of some of our pilots who do not adjust well to the demands of pilot training. Hyperventilation tetany may be the mechanism responsible for "freezing to the controls" which only too often ends fatally.

PHYSIOLOGICAL AND CHEMICAL CHANGES

Hyperventilation results in excessive CO_2 excretion from the blood producing an uncompensated CO_2 deficit. The HCO_3 is reduced below normal but NaHCO_3 is not lowered correspondingly. The pH of the blood serum is thereby raised and the CO_2 combining power is increased. There is an apparent decrease in oxygen consumption following hyperventilation but this may be accounted for by the fact that during the early stages oxygen intake is increased and consequently alveolar oxygen tension is increased. Until the oxygen tension is restored to normal by a decrease in total ventilation, the oxygen consumption is decreased. Blood chlorides are usually ele-

vated and calcium is normal which probably accounts for the reason why calcium does not help to relieve tetany in these patients. Phosphates are usually increased and this may be another mechanism in helping to produce tetany.

Urine pH is increased because there is a deficit of HCO_3 in the blood and an effort is made to restore the normal relationship of $\frac{\text{HCO}_3}{\text{NaHCO}_3}$ by increasing the excretion of NaHCO_3 in the urine. The amount of ammonia is diminished. The reason for this reduction is that ammonia excretion follows the hydrogen ion concentration and titratable acidity of the urine. These in turn depend on the relative concentration of acid and basic radicles of the plasma. There being less titratable acidity of the urine, less ammonia is excreted. An easy way to follow the urine pH in patients under treatment is to have the patient test his urine with nitrazine papers and keep a record of his findings.

Hyperventilation usually causes an increase in heart rate but not necessarily an increase in cardiac output (minute volume) because of a decrease in venous return. The systolic blood pressure is usually increased but sometimes is not affected and other times is reduced. Pulse pressure is usually increased. The reasons for the increase in heart rate are not clear. In individuals who hyperventilate because of anxiety it may be argued that the increase in pulse rate is due to stimulation of the cardiac center by the increased amount of adrenalin in the blood stream (6). However, if normal individuals are hyperventilated, tachycardia will result and several different mechanisms may be responsible: First, the increased metabolism partly due to increased muscular action; second, decrease in plasma CO_2 tension which causes a rise in heart rate for reasons too numerous and complicated to consider here; third, cerebral anoxemia; and fourth, decrease in venous return. Wolff and Lennox (13) have shown that hyperventilation causes cerebral vasoconstriction and it may be this mechanism which produces a sense of suffocation.

In a few individuals hyperventilation produces vasodilation and increased skin temperature characterized by flushing of the face, arms, and hands, but in the majority, vasoconstriction and decrease in skin temperature, particularly of the hands and feet, are the rule. The reason for this seems to be that decreased CO_2 tension causes an increase in tone of the smaller veins and peripheral arterioles thereby causing vasoconstriction. Mulinos and Shulman (7) have demonstrated that deep breathing is capable of producing skin temperature changes similar to those produced by smoking, and Weatherby (8) states that "Various physiologic and psychic stimuli, such as reading, talking, sudden noises, drinking cold water, and hyperventilation may cause changes in skin temperature comparable

to those produced by smoking." He further states that the smoking of a cigarette by the average nonsmoker (without inhaling) causes only slight changes at the most. It is possible that the reduction in skin temperature following smoking may be as much a result of hyperventilation as of nicotine and many of the unpleasant symptoms of excessive smoking heretofore attributed to nicotine may in part be due to hyperventilation. The whole subject of the effect of tobacco smoking on man is confused and will bear much careful study.

Alkalosis and local anoxemia are both factors in the production of tetany but the increased muscle tone is apparently not one of the causes of hyperactive reflexes (6).

The above physiological and biological changes are not by any means the only changes which occur after hyperventilation nor do these alterations furnish complete explanations for all the symptoms of the individuals with anxiety states with hyperventilation. It must be remembered that overstimulation of the autonomic nervous system accompanies all anxiety states, and depending upon whether the sympathetic or parasympathetic system receives the greater stimulation, will in turn determine the pattern of the patient's symptoms; and indeed, sometimes there appears to be an overstimulation of parts of both systems. However it is not the purpose of this paper to discuss the pathogenesis of symptoms of the anxiety states but further investigations will undoubtedly help to clarify the mechanism of production of symptoms and to emphasize that the anxiety state is a disease of the whole individual including his psychic, functional, and organic components.

TREATMENT

The treatment of this type of patient can be one of the most difficult problems in medicine and at times one's patience is tried to the breaking point. Nevertheless, these individuals are often extremely grateful and any relief the physician can give them is genuinely appreciated.

There is however one type of individual who is a frequent sufferer from anxiety and hyperventilation who must be differentiated from the others. He is the constitutional inferior. If these persons are recognized early and it is realized that you are dealing with "poor stock" and that they will probably always have aches and pains in spite of your best efforts, a great deal of time and expense can be saved both the doctor and the patient. Alvarez (9) has recently written an excellent article on the constitutional inferior. It is not meant to imply that these individuals should not be treated; they should be but usually their problems are such that they do not need a physician's care but rather the help of a psychiatric social service worker who often is in a better position to help

them than a doctor. Likewise social service agencies can furnish great help for these unfortunates.

Treatment includes both psychiatric and symptomatic measures. Most of these patients can be treated successfully by the patient's own physician, be he a general practitioner or specialist. One of the oldest of all therapeutic measures, namely kindness, will go a long way in establishing good rapport between doctor and patient, and once this has been attained the patient will usually unburden all his troubles. The fundamental factor underlying the anxiety which in turn sets off hyperventilation and the symptoms of the anxiety state is fear. Fear is initiated when the individual is unable to adjust to or deal satisfactorily with adverse or unusual factors. Any psychic trauma if it is important enough to the individual is capable of producing fear and its consequences. The initiating traumata will be found to be innumerable and the physician will see a panorama of the frailties of human nature if he treats many of these patients. Financial worries, marital difficulties, sexual maladjustment between married couples, philandering husbands, unfaithful wives are among the most common causes of anxiety. Nowadays worry over loved ones away at war, fear of superior officers, or inability on the part of the soldier, sailor, marine, or aviator to adjust to the new and strange situation in which he suddenly finds himself are common causes of anxiety. Sometimes, try as the doctor will, he can uncover no obvious reason for his patient's illness. In these individuals the original trauma may have happened many years earlier and may be buried deep in his unconscious mind. When this is discovered the patient should be referred to a psychiatrist who possesses the specialized knowledge to deal with these problems. It was stated earlier that the patient's own physician can treat most cases successfully, but when indicated the help of a psychiatrist should be sought.

While psychotherapy is being carried on it is important that symptomatic treatment be administered at the same time. In most of these patients a vicious cycle is present. First comes the fear-producing stimulus, then the anxiety state with its symptoms and those of hyperventilation. The patient may or may not forget the original trauma but he now focuses his attention on his symptoms which in turn cause anxiety and hyperventilation and so on ad infinitum. If this cycle can be broken a cure can sometimes be brought about even though the original cause is not discovered or re-evaluated by the patient.

Since alkalosis is responsible for the symptoms of hyperventilation, methods which will prevent alkalosis are beneficial. A mixture of 2.5 to 5 percent CO_2 and oxygen administered to the patient through a mask will relieve the symptoms in less than a minute. If such a mixture is not available rebreathing into a paper bag fitted tightly over the head will accomplish the same purpose within 3 to 10 minutes.

When a patient notices himself hyperventilating and feels symptoms coming on, holding his breath for 10 or 15 consecutive breaths as long as possible will often avert the attack. Holding the breath allows CO_2 to accumulate, thereby lowering the plasma pH and preventing alkalosis. An acid ash diet is beneficial and each patient should be questioned to make sure he is not eating excessive amounts of citrus fruits which are alkaline ash. Soley and Shock recommend that the patient be taught abdominal breathing because the total ventilation is reduced by this type of breathing.

It must be impressed upon these patients that the cause of their symptoms is overbreathing and the best way to do this is actually to hyperventilate them and then relieve their symptoms by having them rebreathe into a paper bag or breathe a mixture of CO_2 and oxygen if it is available. When the patient realizes that his doctor can produce and relieve his symptoms at will, a great distance on the road to cure will have been covered. Acidifying salts if given in the proper dose will keep the blood pH at such a level that even though hyperventilation persists alkalosis will not result. Calcium chloride or ammonium chloride will accomplish this purpose. Ammonium chloride can be administered in capsules or enteric-coated pills up to 6 grams daily. The patient can be taught to regulate the dose himself by using nitrazine papers to test his urine and taking enough ammonium chloride to keep the urine pH below 6.5 or 6.0. Some patients do not tolerate this drug well.

Sedatives should be used when indicated but should not be used in instances where the patient is already depressed. Numerous sedatives can be used and the doctor should not hesitate to use them in adequate doses when they are indicated.

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MEASLES

From April to September 100 cases of measles were managed as follows:

Placed in isolation until 24 hours after fever subsided, then transferred to the general ward where they mingled and messed with the other patients. Most of the cases presented a rash when transferred. There were no cases of cross infection. The average number of days in isolation was 2.3 percent. As compared to the average as given in our medical reports for 1940 there is a great reduction in sick days. It suggests that in many cases measles are kept in isolation too long with a great wastage of sick days.—Thomas, G. E., Captain (MC) USN: Memorandum on Medical Matters of U. S. Marine Corps Base, San Diego, Calif., October 10, 1942.



MUMPS

From April to September 100 consecutive cases of mumps have been treated according to the following procedure:

Five days in bed in isolation, on the sixth day transferred to general ward where he mixed freely with other patients and used the infirmary mess which fed over 250 men. There has been no case of cross infection. The average time on the list was eleven days, a saving of 6½ days per man over the average in our Bureau reports for 1940, which was 17½. This points to the conclusion that we can materially reduce the average number of sick days per case of mumps without harmful results to the patient or danger of infection from him.—Thomas, G. E., Captain (MC) USN: Memorandum on Medical Matters of U. S. Marine Corps Base, San Diego, Calif., October 10, 1942.

COMMON NEUROPSYCHIATRIC PROBLEMS ENCOUNTERED AT A NAVAL TRAINING STATION¹

ALEXANDER LEVINE

Lieutenant (MC) U. S. N. R.

The neuropsychiatric problems encountered at a naval training station are entirely different from those seen in civilian practice. They consist primarily of personality handicaps, which render the recruit unfit for naval service. Only occasionally do cases of frank clinical conditions come to the attention of the psychiatrist. Applicants for the Navy, having obvious neuropsychiatric conditions, are usually eliminated by the recruiting officer at the time of the initial examination. However this preliminary examination is often insufficient to detect recruits having preclinical conditions, or neurotic or personality defects, which make them potential psychiatric casualties. It is the function of the psychiatrists stationed at the various training stations to weed out these misfits before they advance beyond the training period. The method utilized for discharging these recruits from the Navy has been ably described in a communication by Wittson, Harris and Hunt.²

One must realize that membership in a wartime military organization places a great deal of abnormal strain upon an individual. Many recruits who have been able to get along under simple conditions, subject to minimal pressure, such as working on a farm, in a mill, and clerking in a store, cannot withstand the increased stress and tempo of naval life. In spite of sincere and strenuous efforts, their latent personality limitations do not permit them to adjust themselves and the end result may be the development of a neurotic symptomatology, or somatic difficulties on a psychogenic basis. These recruits are misfits and usually do not require any psychiatric aid beyond removal from the traumatic environment.

NOSTALGIA

Upon entrance into the Navy recruits lose the sense of security and protection which the presence of family and friends can evoke. Many of them have never been away from home before. They feel transplanted into strange surroundings with a different set of standards. They have to go about making new friends, are subject to rigid discipline, and are exposed to numerous fantastic rumors about "shots," and examinations they have to undergo while in detention. No longer

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²Wittson, C. L.; Harris, H. I.; and Hunt, W. A.: Detection of the neuropsychiatrically unfit. U. S. Nav. Med. Bull. 40: 340-346, April 1942.

can they turn to the family or friends for advice and comfort. This sudden uprooting seems to be a major factor in the production of nostalgia. It is especially prone to appear in recruits who are immature, inadequate, and insecure. Fortunately, the usual type of homesickness is short-lived and subsides within a few weeks when better orientation occurs.

Nostalgia is a problem of major proportions, and should be treated as such. The homesick recruit needs sympathy and understanding, and the desire to unburden himself leads him to turn to the most likely parent substitute. This is rarely an officer outside the Chaplain Corps, since the gap between the enlisted man and the officer in the Navy, as it is constituted today, is too great to allow for sufficient rapport in problems of this nature. His platoon commander, the chaplain and the Red Cross are most ideally fitted for this role. They must be cognizant of the necessity for patience and understanding. Careful handling on their part will tide the recruit over a most critical period in his naval service. The catharsis achieved by permitting him to "weep" on somebody's shoulder has a distinct therapeutic value. Brusque treatment may do a great deal of harm, and prolong what would otherwise be a transient and self-limited condition.

Occasionally, nostalgia persists for prolonged periods, and may be associated with marked depression and ideas of suicide. In these cases marked personality defects and neurotic characteristics form the fertile soil for the development of this condition. There is usually marked dependence on the parents with a strong identification with one of them. We must always bear in mind that a recruit who is homesick may try to exaggerate his complaints, and even malingering, in order to obtain a discharge.

MENTAL DEFICIENCY

This accounts for a fairly high percentage among recruits receiving discharges for psychiatric conditions. This type of case is most often recognized during the routine psychiatric interview which each recruit undergoes upon arrival at a training station. The mental defective usually gives a poor educational history, with little schooling and numerous failures. In many cases records of scholastic attainments are not very reliable because in some rural schools promotion standards are not based on learning but upon the age of the pupil. As a result we occasionally come across a mentally deficient recruit who has advanced far in grade school and yet is unable to read or write.

The problem of mental deficiency is especially acute among Negro recruits, in that their opportunities for education are more limited than those of the white recruits, and their racial reticence and char-

acteristics often make them present a superficial appearance of intellectual inferiority. Because of these factors, they tend to have a lower score on the standard intelligence test. In view of these findings, and because most intelligence tests have not been standardized for Negroes, one must actually add a bonus to the colored recruits' scores on the psychometric test.

The mental defective always presents a problem in the Navy. He has difficulty in learning and obeying orders. Because of the intellectual deficit he is suggestible, easily led, and lacking in judgment, and often becomes a disciplinary problem. The intellectual retardation may be accompanied by lack of motor coordination which makes for poor service material. He is slow in comprehension, unable to assume responsibility, and requires rigid supervision.

The illiterate who has inadvertently gotten by the recruiting officer, and who is not mentally deficient, is also a misfit. In spite of an ardent desire to do his part, he frequently has difficulty in adjusting. He is unable to read orders, and keenly feels his lack of education. Letters from home have to be read and answered by his fellow recruits. He is sensitive over his deficiency, and depression and dissatisfaction are the rule. These tend to produce decreased efficiency. Commanding officers feel that these individuals are dangerous aboard ship in that they cannot read vital signs. If they pass the recruiting officer, they should be eliminated before they advance in training.

PSYCHOPATHIC STATES

The recruit with a psychopathic personality usually has a long-standing history of maladjustment, with poor school and work records. At school his attendance was irregular, and characterized by frequent arguments with teachers and fights with other pupils. He has had numerous jobs, none of which he retained for long periods, because of his impulsiveness and irresponsibility which bring him into conflict with his employers and fellow employees. In many cases one can obtain a history of repeated delinquencies, many arrests, extensive stays in reform schools, alcoholism, and marital difficulties. He has been a burden to his family, who come in conflict with him when they attempt to curb his activities. This leads to quarrels and fist-fights. Members of the family are frequently the instigators in persuading this type of recruit to enlist in a military service, with the hope that Navy life may change him. The psychopath is at his worst in the naval service. He is the recruit who is frequently brought to mast for various offenses, such as A. W. O. L., insubordination, refusal to obey orders, and stealing. He will not submit to discipline and is always resentful of authority. Because of his personality make-up he is irresponsible, unreliable,

impulsive, and lacking in judgment. As far as he is concerned rules and regulations were made to be broken. He is always a source of trouble because he impairs morale and often misleads other recruits.

Also included in the psychopathic states are individuals with inadequate personalities. These recruits are ineffectual, slow of comprehension, and awkward in drilling. Frequently, they have inferior intelligence, but are not mentally deficient. Prior to enlistment they have adjusted at a fairly low level, working at unskilled occupations, and do not fit into a military organization where there is a greater demand on each individual. They often develop feelings of inferiority and vague somatic complaints to compensate for their shortcomings when the pressure becomes too great. They are usually reported by their platoon commanders as being slow in learning, having poor motor coordination, and being unfitted for naval service.

· ENURESIS

This condition is surprisingly common among the psychiatric problems seen at this training station. Ordinarily enuresis rarely persists beyond adolescence, and is considered to be an infantile trait. A great many of the southern recruits come from rural communities and are subject to poor economic and social conditions. These factors in addition to large families, broken homes, and lack of individual attention tend to produce insecurity and fixations at infantile levels. The end result is relative immaturity which is so often found in the enuretic. This may account for the frequency with which this condition is encountered at this training station. The enuresis should be considered as a symptom and not a disease entity. It is a neurotic trait and is often associated with other manifestations, such as somnambulism, severe nail-biting, night terrors, and generalized nervousness. The family history usually reveals that other members of the family are similarly afflicted, or have other neurotic difficulties. The reason for this is that the same environmental factors which are responsible for the presence of enuresis in the recruit, operate for other members of the family. The recruit and the other members of the family become so accustomed to this condition that they rarely seek medical attention and attribute the bed-wetting to "kidney disease."

Attempts at superficial therapy, such as frequent awakenings at night, restriction of fluid intake, and disciplinary action to make enuresis uncomfortable, have no or little effect on this condition. A temporary cessation of the enuresis may be produced by these methods, but the background is unaltered. The recruit may attempt to utilize various means in order to escape detection. He may sleep on a towel, or hide his bed sheets.

These bed-wetters are undesirable in that they create a hygienic problem aboard ship. Other recruits will complain of the odor and tease the unfortunates about their affliction. This in turn tends to increase the insecurity already present in these individuals. In addition the enuresis is a part of a symptom-complex indicating a neurotic personality which will have difficulty in adjusting.

SOMNAMBULISM

Somnambulism is similar to enuresis in that it is not a clinical entity per se but a manifestation of a deep-seated neurotic disturbance. Frequently it is associated with night terrors and anxiety dreams and may occur several times weekly. It is a disturbing spectacle to see a sleepwalker run screaming through the barracks in the middle of the night. It has a tremendous effect on other recruits whose nerves are on edge due to wartime conditions. In a great many cases other members of the family have the same disorder or other neurotic traits. The somnambulist is always in potential danger in that he may sustain injuries while sleepwalking. Sleepwalkers have fallen down stairs, out of windows, and bumped into objects during these episodes. In some cases in order to prevent injuries, somnambulists keep the windows and doors of their bedrooms barred. In the Navy they run the risk of falling overboard or down a ladder. When discovered these recruits should be eliminated from the service.

ANXIETY STATES

In these individuals there is a great deal of superficial tension which can be evoked by numerous situations. They are tense, tremulous, and frequently complain of precordial pain and palpitation. Attacks of "nervousness" associated with palpitation and choking sensations often appear without any apparent precipitating cause. These recruits have difficulty in performing their duties and cannot endure any excitement. They are always under tension and many of them show marked vasomotor instability as manifested by excessive perspiration, coldness, and mottling of the extremities. Nail-biting, restlessness, and difficulty in relaxation are common occurrences. Chronic "worriers" may be classified in this category. They are always worried about happenings at home and about the quality of their work. Many of them feel insecure and inferior. They tend to be perfectionists and become confused when confronted with extraordinary conditions. If the condition persists they are prone to develop insomnia, loss of appetite, gastro-intestinal symptoms, and frequently lose weight. They often find their way into medical wards

as suspected ulcer cases. They go to pieces under combat conditions and are potential casualties.

NEURASTHENIA

The neurasthenic recruit is a frequent visitor at sick call. He complains that he gets tired easily, cannot drill, and that the exercises are too much for him. He is constantly requesting "light duty slips" because he feels that the work is too hard for him. Prior to enlistment, he visited numerous physicians for a variety of somatic complaints without getting any relief. The most common complaints are headaches, dizzy spells, and backaches. Their work records are poor because of their inability to hold a job for any period of time. They always rely upon their supposed physical infirmities to explain their shortcomings. In addition, one often finds neurotic traits, such as enuresis, somnambulism, and severe nail-biting in these neurasthenic individuals. The family history is quite revealing in these cases in that other members of the family may be similarly constituted, and have identical disabilities. Occasionally there is a strong identification with a relative who has somatic difficulties resulting from an organic condition. The neurasthenic recruit will often take over these physical complaints. These recruits do not fit into a military service and are a source of exasperation to the medical officers who are called upon to treat physical complaints which have no organic basis.

HYSTERIA

This is more common than usually expected among recruits. Although extreme examples of conversion hysteria with paralyses, blindness, and aphonia are fairly rare, one frequently comes across cases of transient, mild hysterical symptoms. Sometimes these recruits have a slight organic defect upon which rests an hysterical superstructure which manifests itself when the "going gets tough." The complaints may be headaches, dizzy spells, "blind staggers," weakness of a limb, poor vision, and partial deafness. When questioned, these recruits state that they like the Navy and want to remain in service, but in view of their disability they do not see how they can get along.

They are very suggestible, and varying and bizarre sensory disturbances can be induced at will by the examiner. The individual with the hysterical type of personality will give a history of similar disturbances in the past, occurring at critical periods. It is a matter of interest that this type of reaction seems to be more common among colored recruits. Possibly this is due to the fact that somatic conversion is a more primitive type of psychological mechanism.

Although the prognosis for each attack is good, yet there are no means at our disposal for correcting the underlying, basic personality

defect responsible for these manifestations. We can never be sure whether or not similar disabilities will occur in the future if like conditions are present. The affliction is self-limited and responds readily to any form of psychotherapy. These individuals are not fitted for duty and should not be retained in service.

EPILEPSY

This condition is seen fairly frequently by psychiatrists at a naval training station. Unfortunately, many epileptics attempt to hide their affliction when enlisting, and even upon direct questioning after arrival at the station. However, following their first seizure after enlistment, they usually readily admit having had convulsions in the past. Some of them even go to the point of carrying tablets of phenobarbital which they take regularly. A few, hoping to remain in the Navy, repeatedly deny any previous episodes. It is true that a rare case of epilepsy may start with the first seizure taking place following enlistment. A social history obtained via the Red Cross is often instrumental in establishing an EPTE (existed prior to enlistment) condition.

In view of the youth of the recruits, the common stigmata of epilepsy, such as scars on the tongue or face, and personality disturbances resulting from organic deterioration of the brain, are not found. Petit-mal attacks may or may not be present. Frequent syncopal episodes without the tongue biting and convulsive movements may fall into this category. At times hyperventilation may be successful in inducing a convulsive seizure in a recruit suspected of having epilepsy. An epileptic attack occurring during sleep should not be misinterpreted as a nightmare.

MIGRAINE

This diagnosis is often used as a pigeonhole for cases of atypical headache. Migraine is a condition characterized by headaches, usually unilateral, associated with blurred vision and gastric disturbances. It is familial and recurs at fairly regular intervals. It has been our experience that many recruits complain of familial incapacitating headaches, which are bilateral. Spots in front of the eyes, blurring of the vision, dizziness, and gastric disturbances may be present. The history will reveal numerous occasions during which these recruits have been forced to quit work for varying periods because of their disability. Hard work, bending, and exposure to the sun often act as precipitating factors. Syncopal attacks may follow the onset of the headaches. They have received medical attention in the past and have been told that the headaches are due to sinus involvement or eye-strain. However, examinations including x-ray studies fail to

reveal the presence of any pathology in the sinuses, and eye refractions are negative. These individuals are frequently emotional and manifest vasomotor instability.

ALCOHOLISM

The alcoholic recruit always presents a problem no matter where he is placed in the Navy. He is unreliable and irresponsible, and the alcoholism is usually but a symptom of a deep-seated personality disturbance. It is frequently seen among psychopathic personalities. The tremulousness of the recruit is a "dead give away." Frequently, there is a history of numerous arrests for intoxication, marital maladjustment, and a poor work record. He is fired from many jobs and may take up a nomadic existence. To him, alcoholism represents an escape mechanism and a means of forgetting his difficulties. He has no insight into his condition and will often deny overindulgence. Before an alcoholic bout he feels tense, restless, and jittery. One drink leads to another and there is no stopping until complete inebriation results. Many recruits with an alcoholic history will state that they enlisted in the Navy because they thought that discipline and Navy life would straighten them out. On their first liberty, in spite of good intentions, they will commit various offenses, such as fighting with civilians or overstaying their liberty, and will not be fit for duty. Although some alcoholics appear to manifest excellent qualities in between drinking episodes, they are not to be trusted and should be eliminated from the service.

TRAUMATIC SEQUELAE

Some recruits will complain of headaches, dizzy spells, and blurred vision, which they attribute to a head injury sustained sometime in the past. The severity of the head injury with the length of unconscious interval seems to have no correlation with the severity of the complaints. Intensive questioning will sometimes reveal that their complaints antedated the alleged injury or that other members of the family have similar complaints without having had any head injuries. It is customary for patients with "head trouble" and for their families to attribute the disability to a head injury, either real or imagined. Most of us have had, at some time or other, trauma to the head without any sequelae. Of course in many cases we can obtain a clean-cut history of a good adjustment with no somatic difficulties until a head injury occurred. Following this, there is a change in health and personality. Neurological signs, such as nystagmus or tremors, may or may not be present. These recruits are usually affected by changes in posture, hard work, and hot weather, which may precipitate their

complaints. Occasionally, syncopal attacks may occur. A common finding is that they have a decreased tolerance for alcohol.

Cases with histories of previous head injuries form the greatest proportion of the group referred to the psychiatrist for post-traumatic sequelae. Infrequently, injuries to other parts of the body may initiate recurrent complaints, with no apparent physical basis. This category fits those recruits who have had some operative procedure performed, such as an appendectomy, and have persistent postoperative complaints. There is a fixation at the site of the operative scar, so that disabling symptoms are attributed to this region.

PSYCHOSES

Frank psychoses among recruits at a naval training station are comparatively rare because psychotic recruits rarely get by the recruiting officer. Since the majority of recruits are in their late teens a psychosis usually has not had the time to develop. Instead, we may see recruits who have prodromal syndromes and are borderline in their symptomatology. These individuals have adjusted on a low level prior to enlistment. There seems to be a paucity of drive, initiative, and ambition. They are usually seclusive and indulge in day-dreams. This introversion leads to a turning away from reality and a steadily increasing reliance upon their own dream world. Furthermore, they lack social consciousness and feel uncomfortable in the presence of others. Cases further advanced may manifest suspicion and evasiveness. A prolonged interview may reveal occasional blocking of thought, circumstantiality of speech, and scarcity of ideas. These recruits are potential psychotics and should be eliminated as soon as possible from the naval service.

In addition, recruits who have a history of previous hospitalization in a mental institution for a nervous disorder should be disqualified automatically. This procedure should be followed even if there appears to have been a complete remission with apparent cure. It is felt that recruits who have had a nervous break-down in civilian life may suffer a relapse when subjected to the abnormal tension encountered in military service.

One must be exceedingly careful in diagnosing the presence of a psychosis in a recruit who states that he has occasional hallucinatory experiences. To interpret these experiences one must take into consideration the ideology and cultural background of these individuals. Many of them are extremely superstitious and very religious, so that it is not uncommon for them to see visions of God, dead relatives, etc., and to hear voices. It must be borne in mind that severely neurotic or depressed individuals may be subject to hallucinations. Schizophrenia should never be diagnosed merely because of the presence of these manifestations, without concomitant personality distortions.

MALINGERING

Malingering is not as frequent a finding as one would expect. This is probably due to the fact that all recruits in the Navy are volunteers, although undoubtedly many enlist to avoid being drafted into the Army. Malingering may occur in the homesick recruit, who shortly after arrival at a training station hears that enuresis, somnambulism, etc., are disqualifying afflictions. He may utilize these manifestations in an attempt to be discharged from the service. However, his statements can be checked by adequate social histories. A few days in the sickbay are often sufficient for a recruit to get over his homesickness and he will voluntarily confess.

One must consider true and persistent malingering as a psychiatric disorder. It is all well and good to detect a malingerer and to return him to duty, but we often find that he has a psychopathic personality and he utilizes malingering as a means of evading responsibility and unpleasant situations. Return to duty for this type of recruit just means giving him another chance to use the same methods if similar circumstances arise. He is a constant plague to the naval physician whether ashore or at sea. We feel that this recruit is not fitted for duty and when detected should be granted a discharge. Punishment has no corrective value, but is only a temporary measure.

A few brief remarks should be made concerning the "negative" malingerer. He is the recruit who attempts to hide the presence of some disability because he is anxious for naval service. Epileptics, somnambulists, and enuretics frequently fall into this classification. They are difficult to discover until they have a fit, walk in their sleep, or wet the bed. They will often resort to all sorts of subterfuges in order to avoid detection. In suspicious cases, an adequate social history as can be obtained by the Red Cross will reveal the true facts.

SUMMARY

Common neuropsychiatric problems seen at a naval training station have been discussed. It is emphasized that the vast majority of cases handled are not full-fledged clinical entities, but have personality defects which disqualify them for military service. In a great many recruits these limitations are latent and will not become manifest except under the strain of military life and combat conditions. War is an abnormal situation and those individuals most closely approximating normalcy have the best chance for survival. A change of status from civilian to military life will often bring out hidden anxieties and symptomatology which will handicap the recruit in his adjustment. These men should be eliminated

before they complete the training period and become the responsibility of the Government. As a rule they do not require psychotherapy, because the ordinary demands of their former environment do not place too great a strain upon them. In this way we can avoid having potential psychiatric casualties and improve the morale and efficiency of the service.



DISABILITIES AMONG PARACHUTE TROOPS

Injuries among these troops are many and frequent. Four types of injuries are particularly outstanding and may be considered as peculiar to this type of training. They are: Ankle sprain; strain of peroneal muscle; strain of rectus abdominis muscle; and strain of lumbar muscle.

With strain of peroneal muscle frequently there have been fractures of the fibula in the upper half and many hernias result from strain of the rectus abdominis muscle. One hundred cases of acute ankle sprain have been treated with injections of 1 percent procain and without strapping. These cases were instructed to walk immediately. The average loss of time from active military training has averaged 2 days, a distinct saving of time as compared to the results in cases treated by adhesive strapping.

Examinations of parachute troops after 2 weeks' training has revealed the fact that about 40 percent of the men show systolic murmurs at the apex. This is interpreted as the same murmur found in young individuals after severe exercise. It is likely to be a normal murmur associated with some temporary dilatation of the left ventricle with stretching of the valve ring of the mitral valve. They live a strenuous life and I am not surprised. Most of the parachute troops also present a lower than average blood pressure.—Thomas, G. E., Captain (MC) USN: Memorandum on Medical Matters of U. S. Marine Corps Base, San Diego, Calif., October 10, 1942.



DENTAL AND MEDICAL INSTRUMENT DRIVE A SUCCESS

Four new Coast Guard stations will be equipped with medical and dental instruments contributed by Iowa doctors, dentists and others in the recent salvage campaign conducted by radio and the press throughout the State. Iowa's donation of a total of 76 boxes weighing approximately 5,000 pounds was received in December by the Medical and Surgical Relief Committee of America, 420 Lexington Avenue, New York City, which is sponsoring a national drive to obtain old instruments for reconditioning and eventual use by the armed forces and our Allies.—Jour. Iowa State Med. Assn., 33: No. 2, February 1943.

THE APPRAISAL OF NAVAL PSYCHIATRIC CASUALTIES BY THE RORSCHACH METHOD

THOMAS W. RICHARDS

Lieutenant, H-V(S), U. S. N. R.

This report deals with the use of the Rorschach ink-blot test in cases of psychiatric casualty apparently precipitated by combat conditions. It is a preliminary report in the sense that it deals with relatively few cases, but it is believed that the cases are fully representative, and that the urgency of adopting useful techniques warrants its presentation at this time.

The literature on the Rorschach method has been increasingly abundant within the last 5 years. Rorschach's own concepts, together with the results of considerable research and experience with it since his death, have been presented in a recent book by Klopfer et al.,¹ to which the reader is referred for detail as to the method itself. Few reports have appeared to date regarding the use of the method in military work. Brussel and Hitch² have shown its utility in recruit appraisal, and there have been incidental reports of its use in selecting flying personnel.

For those unacquainted with the method, it might be stated that the situation for the patient is one in which he is presented with relatively meaningless material—10 standard ink blots—and asked to tell what they might be. Some of the blots are colored, others are black and white or gray. Some present definite form characteristics, others are vague. The characteristics of the blots used by the subject, the content of his responses and other aspects of his performance may be compared clinically or to some extent statistically with those of other individuals. Since the blots themselves portray no real object the subject's responses express the pattern of his personality.

Previous studies have shown characteristic patterns for various personality types, and for more or less pathological conditions. Among tendencies most clearly suggested by the Rorschach performance are the anxious, the repressive, hysterical, compulsive-obsessive, and the psychotic.

Cases of combat casualty were given the Rorschach test. Nothing was known about the patient other than his corps, rate, and age.

¹ Klopfer, Bruno, and Kelley, Douglas M.: *The Rorschach Technique; A Manual for a Projective Method of Personality Diagnosis*. World Book Co., Yonkers-on-Hudson, N. Y., 1942. pp. 12 and 488.

² Brussel, J. A., and Hitch, K. S.: Rorschach method and its uses in military psychiatry. *Psychiatric Quart.* 16: 3-29, Jan. 1942.

After the patient's performance was recorded, the record was scored and interpreted. Only after the Rorschach interpretation had been written was the man's health record examined to learn the history and the diagnosis, tentative or otherwise, which had been applied to the patient.

A brief sketch of the circumstances of the casualty and the patient's subsequent reaction will be presented for each case, following the personality sketch developed from the Rorschach.

CASE No. 1—A Lieutenant (J. g.), USN, age 41 years

RORSCHACH SUMMARY

He appears to be in a grossly anxious state at this point, to the extent that he is afraid to express himself at all, yet he betrays his essential capacity for expression on several responses. He seems to be a man who, realizing that he has lost the capacity to express himself, takes refuge in formal, well-understand avenues. He shows depressive phenomena, not as psychotic as they are neurotic. It is apparent that the patient is basically in good contact with reality, but the neurotic anxiety is so strong that his reaction pattern is completely governed by it. Whereas many men in such condition might find refuge in childish expression—absorption in basic sex or aggression, etc.—he is trying desperately to retain a vestige of his identification with the intellectual world.

He is still an officer—still is concerned with the task of denying his animal nature and behaving like an example. This task is at present frustrating—hence the anxiety and repression.

The patient's responses indicated a traumatic background for his present situation. On one card he gave a singularly uninhibited response, indicating a complex of considerable aggression plus anxiety and feelings of guilt. Possibly the patient is worried not only about danger to himself but injury inflicted on others.

His anxiety is extreme and his behavior as a result is ineffectual.

HISTORY

He has been in the Navy some years, being promoted from the ranks. He finished the seventh grade at 16, has been married 10 years. Has one child. Although he had sibs, he was raised practically as an only child, his next older sib being 20 years older than he. His father died of heart trouble, and patient believes he has the same. Prior to seeing action, he suffered a few attacks of precordial pain, angina pectoris (functional spasm).

Patient had been trained for some months prior to engagement in handling landing boats. As the time for landing-party activity approached, he became increasingly apprehensive, "nervous." He developed frequent attacks of heart pains, which coincided with alarms, attacks on the ship, bombings. His greatest concern in all this was being considered "yellow." He insisted frequently that he was not "yellow," having spent some months previously without a qualm going through mine fields, etc.

The frequency of "heart attacks" led to his detachment and referral to the hospital. At the hospital he showed frequent absent-mindedness, an intensification of his concern about being considered "yellow." He showed a distinct pallor, seemed apprehensive. Diagnosis: Cardiac neurosis.

CASE No. 1.—A private, USMC, age 30 years

RORSCHACH SUMMARY

He shows little anxiety on his record. He is a sensuous, uninhibited, frankly sexual man who preserves a curious intellectuality with this tendency. His observation is sensible and accurate and to the point. Basically, he is quite uncivilized—he shows no refinement or culture excepting in the social area. He worries not at all about his own lustiness; is concerned only where he may tread on someone else's toes. Hence he has acquired a certain degree of tact and polish in his social contacts. That his objectives are clearly sexual he would certainly admit to himself. Possibly he is homosexual, at least covertly.

HISTORY

In the field a bomb exploded within a few feet of him; he was found some hours later wandering about in a dazed condition, both eardrums ruptured. At that time he was given tentative diagnosis of intracranial injury. During the period from this point until he arrived at the hospital he showed steady improvement. When examined on admission to the hospital no evidence of intracranial injury was found. To the psychiatrist at the time the Rorschach was administered, the patient appeared aggressive, somewhat resentful and resistant, a person of possible psychoneurotic tendency but showing also the somewhat conscious evasiveness of the malingerer. Diagnosis: Undetermined.

CASE No. 3.—A chief pharmacist's mate, USN, age 38 years

RORSCHACH SUMMARY

The evidence here suggests a man of considerable capacity for thinking at a high theoretical level, a man of noticeable spontaneity and a variegated response pattern. He shows a large degree of flexibility in his approach. He is a man who, though probably not highly educated in a formal sense, possesses a rich background of experience, and a background which, furthermore, he can draw upon readily.

He shows with all this, however, a strong anxiety. This anxiety originates not so much from any concern about his emotional ties with the outer world, and with those about him, as from doubts as to his self-control. He demonstrates clear guilt-feelings which he seeks to dispel in introspection and sheer intellectualization. This does not suffice entirely to relieve the anxiety however, but it is probable that the man possesses sufficient resources within himself ultimately to gain a large degree of confidence.

He is a little too concerned about putting himself across—he strains on this. This again is an expression of his

HISTORY

He participated in several landing parties as pharmacist's mate, during which many of his companions were killed. For several days he was under heavy bombing. During this period he took morphine daily, later stopped this of his own accord. He recalls feeling anxious during his first landing, but says he "settled down" following this first experience.

Diagnosis: Undetermined.

feeling of personal inadequacy. But on the whole, his record indicates a fairly well balanced personality. He is neurotic now, shifting possibly to an anxiety hysteria, but he probably is an essentially stable individual.

CASE No. 4.—A sergeant, USMC, age 23 years

RORSCHACH SUMMARY

This Rorschach reveals a man of very clear intellectual capacity; his is an unusually active and creative mind, spontaneous, imaginative. There is no doubt that he has a superior (though untutored) mind. He is a man to whom active intellectual participation is an important function—he uses his capacity without inhibition. He is introverted, in the sense that his world is pretty much what he makes of it. Under conditions of ordinary situational potency, he gets along very well just using his head, thinking his way through. It is probable that he was regarded in his battalion as an alert, intelligent, reliable and, above all, capable man, fairly cool under most conditions. In fact, he probably functioned best under conditions of some slight excitement. His Rorschach indicates that although freely occupied within himself, needing little outside stimulation, nevertheless he flourishes best when there is some demand made upon him.

At present he seems to be somewhat anxious and insecure. Although this condition is not marked, it is shown in several of his responses, particularly on the achromatic series; a clear aggressiveness is apparent, with which the patient is identified as the victim rather than the aggressor. It is also suggested strongly that the subject is anxious in the sexual sphere. He exhibits a frank male sexuality tempered by anxiety and feelings of guilt, a preoccupation with sexual activity from the male point of view almost entirely. Latent homosexuality is suggested. The patient's emphasis on small detail, particularly on profiles, indicates a somewhat obsessional or compulsive trend as a solu-

HISTORY

He spent 3 years in the Army after graduating from high school. In the Army he had an excellent record, joined the Marines a few days after being discharged from the Army. Here he progressed rapidly, working for a period as instructor. In the field he had to undergo daily bombing attacks; he found that regularly before the daily attack was due he commenced an involuntary shaking, which made it difficult for him to carry out his duty during the attack. He went for 3 days without going to the latrine because of a fear of snipers, though his companions did not themselves hesitate. Finally, he found when the "all clear" was sounded that he was in an uncontrollable spell of crying. He was then turned in to the sickbay and transferred subsequently to the hospital.

As a child he recalls fear of thunderstorms; was frightened early in life by his father throwing him in the air; at thirteen he cried after an earthquake.

Diagnosis: Psychoneurosis, war neurosis.

tion for his anxiety. This is not highly developed but it is clear. The patient is probably systematic, orderly, punctual, compliant with orders. He probably has a high sense of duty (which contributes to the anxiety he now feels).

This man of superior capacity, a man of unusual self-insight and self-evaluation has an active, alert mind, and would in my opinion, find considerable relief from his anxiety if given a valid, challenging task to do. His mind is active, and if not put to constructive use, will work itself out compulsively in socially meaningless forms.

CASE No. 5.—A private, USMC, age 21 years

RORSCHACH SUMMARY

He shows in his Rorschach that he is a person of considerable spontaneity; he is extremely sensitive to his environment. Because he lacks confidence in himself he is self-conscious, introspective, anxious. He seems to be convinced that he must make an impression intellectually. This distrust of himself on the one hand and on the other the conviction that he must make an impression, lead to a conflict, which seems to be basic to his anxiety. His personality at this point seems to pivot about the problem of prestige.

He shows at least a slight concern regarding sex: he appears essentially aggressive and impulsive in this area. There is, it seems to me, no doubt of a masculine drive, but the patient seems to feel as if he had to repress himself. Possibly he has developed a need for rationalizing and intellectualizing his sexual urge to sublimate it.

HISTORY

He is the only child of divorced parents, raised by mother and maternal grandmother. Finished high school at 17, joined Marines 2 months later. A boy well adjusted socially, with a good record in the service, though no ambition for advancement.

In active battle, saw a number of atrocities, bayonetting, remembers killing several men with hand grenades, going without sleep for several days, developing an overwhelming desire to kill. On his return from the beach head to his ship, remembers hearing someone talk of snake. From that point on he developed an increased state of tension, with periods of uncontrollable, unprovoked irritability, sleeplessness, incoordinated thoughts and activity. Overactive, antisocial, depressed, obsessed with thoughts of combat. Had some hallucinations regarding snakes; he tried to get poison from pharmacist's mate to put on his bayonet to achieve instant killing of enemy. Became belligerent, profane.

About the ward some months later it was noticed that he was always neat, proud of his uniform. He talked of wearing campaign medals. Showed obvious concern for his prestige. He was still somewhat asocial, suspicious.

Diagnosis: Psychoneurosis, war neurosis.

CASE No. 6.—A seaman, second class, USN, age 19 years

RORSCHACH SUMMARY

His Rorschach betrays a person who is in an anxiety state and who, under stress, gives way to an hysterical mode of response. This anxiety is the result partly of a failure to find within himself the inner resourcefulness which might act as a stabilizer.

Under conditions of minimal environmental stimulation he takes refuge in the impression he makes on others, but this is unsatisfactory. There is a suggestion of a slight schizoid trend, not yet highly developed, but this seems to me very secondary.

Essentially, he seems an hysterical type whose neurotic solution is inadequate and who is thus left anxious.

HISTORY

He is a high school graduate. At 13 he was a case in a child guidance clinic for being "nervous, irritable." He was found bright, but immature.

Aboard ship following general quarters he heard a loud explosion, remembers nothing after that. Woke up later in a transport, recognized five shipmates. Felt there was nothing wrong with him. (His ship was sunk). Actually, he had several burns, was suspected of suffering from immersion in oil. He was found to talk jerkily, to have a roving gaze as if expecting to see something at any moment. Some euphoria.

Diagnosis: Psychoneurosis, war neurosis.

CASE No. 7.—A soundman, third class, USN, age 20 years

RORSCHACH SUMMARY

This man was extremely suspicious and unwilling to reveal himself. What he did reveal indicates that he is in good touch with the world about him, that he is stereotyped and somewhat infantile, but particularly that he is now anxious. He gives the impression to some extent, of malingering, of deliberately covering up; also he appears negativistic and defensive.

(He claims he is color-blind, which is very possibly true. It is unlikely that he sees all the cards as gray, however; he should be tested with the best possible motivation, the Stilling, or any other color series.)

Tentative impression: Malingerer.

Definite impression: Anxious, repressed, at present inadequate adjustment.

HISTORY

He is a high school graduate who had been in the service about 9 months when his ship was sunk. He was picked up about an hour later. Since then he has been nervous and jumpy, especially at any loud noise. Had frequent dizzy spells, even before joining the Navy. Occasionally a sleepwalker, occasionally enuretic. For years has had severe headaches, poor appetite, constipation. (He was not noticeably on the sick list before his accident).

His father was killed accidentally when the boy was five; he was brought up by mother and a stepfather with whom he got along poorly.

Diagnosis: Psychoneurosis, psychasthenia.

CASE No. 8.—A private, USMC, age 22 years

RORSCHACH SUMMARY

His Rorschach indicates a person highly repressed in a crude way. Basically he appears to be extratensive, sensitive to emotional values in his en-

HISTORY

He was the fourth of five children in apparently happy family. Fair schooling, considerable self-education, progress as technician in industry.

vironment. But at this time, at least, he is acutely shocked by these values, and left with little resource for expression. He possesses few resources within himself on which to rely in times of stress; he is a simple, straightforward person of average intellect and background. In a general way he uses a common sense approach to problems he meets. For one of his intellectual background, his experience is diversified and he draws upon it readily. But he is afraid of his own emotional responsiveness. He shows clearly an anxiety regarding his incapacity to handle emotional situations successfully. (Although clearly anxious at this point, he seems to possess adequate balance and common sense to make some adjustment. Prognosis might not be hopeless.)

No previous attacks of anxiety. For 8 hours after a shell exploded near him, he remembered nothing. Was told he had walked about in a dazed condition. Remembered only threshing about later in a hospital bed. Developed episodes of generalized activity, threshing about, etc. These attacks aggravated by noises of ships but particularly of planes. During these, some occipital headaches. One week later, a distinct bradycardia, some sinus arrhythmia. Condition greatly improved, claims he is anxious to get back to company. Memory for recent events somewhat hazy still. One week later, it is noticed that he has become increasingly careless of appearance, has developed a flat detached air of unconcern, while the partial amnesia for recent events continues. Has a tendency to lie about staring vacantly all day. Three months after the onset, patient has developed a lax, listless, careless manner consistently, suggesting conversion symptoms.

Diagnosis: War neurosis, anxiety hysteria.

CASE No. 9.—A seaman, first class, USN, age 30 years

RORSCHACH SUMMARY

This subject was highly disturbed throughout his Rorschach; his confusion and inhibition increased as the record progressed. He gave very few responses—rejecting several cards. This would indicate that he is considerably out of touch with the world about him and together with his pure color response and his "blood" response would suggest strongly that he is psychotic. There is a possibility also of his being an organic case, with the perplexity, general confusion. But he seemed too disarranged for an organic. He tried to hide his confusion by being cautious. (Schizophrenia?).

HISTORY

Before entering the combat zone, he received the tentative diagnosis of constitutional psychopathic state: Inadequate personality. Although while aboard ship he saw considerable combat, his memory for the events of this was slight and vague. He received no injury, was never unconscious in combat. As a boy was raised in an orphanage; had a speech defect for which he was often ridiculed. He had few dates, some but infrequent sexual activity. He showed increasingly symptoms of slow response, insecurity, vague memory, and was referred to the hospital.

Present diagnosis: Schizophrenia, ambulatory catatonia.

CASE No. 10.—A seaman, second class, USN, age 22 years

RORSCHACH SUMMARY

Several factors in his Rorschach suggest that he is in the perplexed, perseverative, stereotyped state of the organic case, but on the whole the spontaneity which betrays itself incidentally and the generally good form, tend to rule out this diagnosis. He is more the strongly impulsive, imaginative child who has burned his fingers and learned therefore to use more socially acceptable forms rather than perfectly frank expression. He does not appear highly agitated or disturbed at this point; rather, he is somewhat hesitant and perplexed. He feels himself in an uncertain position, tends to criticize himself with a certain degree of insight. For an unschooled person, he is to a fair extent cultured, refined and tactful. Indeed, he has found that it pays to be tactful. He is capable of rich, uninhibited sensual experience. But he is wary, careful lest free expression of this bawdy tendency might get him into trouble. He is an "older child", impulsive, free, but with an eye on his elders.

HISTORY

At the time he was enlisted, it was suggested he might be diagnosed as a simple dementia praecox. A schizoid personality is mentioned frequently throughout his record. As a child a withdrawn shy type. Before enlistment had never had a date in his life. On a ship, which was sunk, a shell exploded near him, causing temporary blindness. No gross damage to eyes. For 10 days some amnesia. A month later, while on liberty, visiting a girl's home with a Marine, he suddenly imagined he saw enemy planes, wanted to shoot them down, had no gun.

CASE No. 11.—A seaman, first class, USN, age 22 years

RORSCHACH SUMMARY

This record is obviously a psychotic one. That the man is not mentally deficient is clear from the intellectual quality of some of his responses, and that he is not neurotic is shown by the complete absence of control or inhibition or anxiety. Confronted with the Rorschach situation he responded directly and purely to the color, using only the color-naming device to dispel its threat from him.

He resisted any tendency to do more than respond and put the card away from him but he showed later that there was much more significance in the blots than he would at first admit. What lies beyond the present psychotic

HISTORY

He was an only child; his mother died when he was seven; his stepmother is very fond of him. During childhood he was a model boy, in good health. Finished the eleventh grade; had very few dates.

During 1 year of service was at mast four times. Feels that his master-at-arms always had it in for him, that several of the men were jealous because he made sea. 1st. before they did. Reports of his falling asleep on watch once, being found on another occasion in a somnambulistic state painting without paint on his brush, and other minor incidents indicate rather irresponsible if not psychotic tendencies.

condition is vague. It is suggested that the boy has a cultural background, also that he has learned that an open emotionality is unacceptable. Possibly he has been hurt, in his early home life or since, and this has left a scar.

It is clear that the boy's intellectual capacity is of no use to him now; he is now a creature of the environment around him. In a situation of even the slightest emotional significance for him, his own emotionality becomes dominant and he is psychotic.

Patient claimed he had no trouble with other men, on the whole.

On board ship, patient claims it worried him to have to close watertight doors, locking others in. This worry kept him awake. During one landing-operation it was his job to ferry a "jeep-carrier." Claims he was not nervous during this action. After the attack, when he had returned to the ship, he was found in deep sleep, later in a "black-jack" game, apparently unconcerned about his duties. He was then turned in to sick bay.

Psychiatric examination at the time indicated that memory, retention and recall were good; no evidence of hallucinations or delusions, or clearly of psychosis. He appeared talkative, sometimes overactive and argumentative, profane, cycloid. He pronounced some words with difficulty. During observation in the next few months his restlessness increased, he seemed unable to stick at one thing, shifting activities constantly. Finally, he left the hospital A. W. O. L.

CASE No. 12.—An apprentice seaman, USN, age 18 years

RORSCHACH SUMMARY

In this Rorschach a strongly artistic and sensitive personality reveals itself. He possesses considerable creative capacity (for a recruit) tempered with a capacity to handle emotional ties with the outer world rather well. He shows a broad intellectual background, and the capacity to organize his experience into competently executed patterns. His performance suggests also that his emotional contacts have probably been sometimes disastrous, and have taught him a certain degree of caution in maintaining ties with others. Has he had his fingers burned? (What sort of home background, etc.?)

He reveals some anxiety, not marked, however. His anxiety arises probably from uncertainty in handling himself. He shows an aggressive sexuality, the control of which seems to occasion some

HISTORY

Patient's mother died of cancer when he was twelve, having been bedridden 5 years. She was supposed to have been artistic. Father remarried, boy having difficulty with stepmother. In school, he always had trouble with teachers. Recalled that he never got along well with others; he had a "superiority complex" which others found obnoxious.

In the Navy his C. P. O. reported he had "too much education for the rest of the fellows," didn't fit in, always preferred liberty alone. After seeing men killed in one battle, he began to worry about having to kill people. He went ashore, rented a room, wrote his father his intention to commit suicide (gave his money to some strangers, tore up his identification card, took 475 grains of aspirin). Next morning he awoke, vomited, turned himself in over-leave.

introspective concern. He is a bit of a daydreamer, hence possibly preschizoid. But he has certainly retained his capacity for expression, and on the whole gives a Rorschach considerably suggestive of a basically normal personality.

He had decided "the Lord didn't want me to die."

Diagnosis: Schizophrenia, paranoid personality.

CASE No. 13.—A seaman, second class, USN, age 22 years

RORSCHACH SUMMARY

The perseveration in his record suggests a possible organic condition, but it is more likely that he is schizophrenic, since this perseveration was not consistent, and since he showed a clearly differential response to the chromatic cards. Color inhibited him sharply—he showed clear color shock. The man is highly inhibited, shows some signs of anxiety, though not of a great physical tension. Rather the picture is of a man of more hebephrenic type, showing a lack of integration between his emotional and intellectual activity. Stimulation in his environment upsets him, resulting in his increased constriction.

HISTORY

This patient received the diagnosis war neurosis; later, that of emotional instability. A farm boy, he said, "I always had an ambition to be on the good side of everyone." Parents and several relatives were "nervous type." At Pearl Harbor, was slightly wounded on a cruiser. In action, working on an ammunition hoist, he claims he became nervous from "the pounding of the guns." Shipmates were killed near him. Following this action, he was confined to bed with weakness, inability to stand up, sweats, nausea, nervousness. But in 3 days was returned to duty; climbing the ladder to go aboard, he was so weak he barely made it. His stomach being cramped, it crowded his heart, he became dizzy; when bombers came over for attacks, spots appeared before his eyes; he heard someone call his name, then everything went black. When, in his bunk, a torpedo hit the ship, he felt a terrific pain in his heart. When, the ship having retired from the action, a line was fired to another ship, he was strongly upset by the sudden shot. Several months later, feels that it would be useless for him to go back to duty.

CASE No. 14.—A seaman, second class, USN, age 25 years

RORSCHACH SUMMARY

He showed a high degree of shock on the Rorschach. His responses were limited by a strong repression; those he gave indicate that his capacity is considerably greater than his output. He is not dull, but he is so afraid of expression that his effectiveness now is slight. He seems not to have found even a neurotic outlet for his conflict

HISTORY

Injured in battle with shrapnel wounds and burns, extremely nervous and anxious about his physical condition, the patient was insomniac, hands perspired profusely, showed tremor. These symptoms subsided considerably on transfer to the mainland. He still appeared restless; spoke with deep feeling of seeing shipmates killed near him.

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so that he is in an anxiety state. There are few clues to the nature of his conflict. His responses suggest that violent aggression is an important component, probably associated with battle action. He gave an hysterical response, almost as if he were suddenly in panic after a perfectly normal expression of spontaneity. For a man who had indicated, on certain of the cards a fairly high degree of creative capacity, his responses following VI (a card of sexual potency for many patients) indicated an obliteration of this capacity. He seems totally inadequate to handle himself after having given himself away even slightly. His anxiety appears to result from an intense feeling of guilt.

Had repeatedly the experience of seeing a burning torpedo plane descending on his ship. Two months later, very great improvement, return to duty recommended. Man very anxious to return.

The 14 cases here presented were selected from a larger group examined at the Naval Hospital and at the Naval Training Station at San Diego. They were selected only because they were cases in which the precipitating factors for the psychological difficulty seemed to have been combat; in the remaining cases there was just as strong suggestion of facilitated psychosis and of war neurosis as there was in these combat cases. The reason for emphasizing the combat-traumatic cases at this time was the conviction that these patients represent a type which will demand increasing attention on the part of the Medical Department of the Navy.

If the reader will compare the Rorschach picture given on the left-hand side of the page with the case history and psychiatric impression given on the right, it will be apparent that, although there are occasional discrepancies, agreement between the two is great and the differences between the two pictures generally seem to lend mutual confirmation. It should be kept in mind that the Rorschach requires but a relatively short time to administer, score, and interpret (about 1 hour per case in this series). Hence it would appear to be an efficient way to obtain a picture of the man which, by the usual methods of interview and observation, might require several hours at least.

That the Rorschach technic is a useful procedure in detecting misfits at the time of recruit training is obvious. Its utility at later stages of the man's psychological history in the Navy is less clear, possibly, but certainly no less important. It has been pointed out to the author that the Rorschach examination may be extremely valuable in shedding light on the EPTE.¹ nature of the patient's

¹ Existed prior to enlistment.

difficulty, thus aiding in more accurate and just survey. If it does nothing else, however, the Rorschach technic suggests clues which merit further study. It serves as an auxiliary study which tends to fortify or negate tentative diagnoses. The method itself does not often render neat diagnoses in terms of the conventional nomenclature; it is adequate, however, to detect and describe on the basis of relatively short-term contact many important aspects of the personality which make these diagnoses possible.

As a closing note, it can be suggested without reservation that the Rorschach method, used by trained examiners, should be a part of the routine procedure whenever psychiatric casualty is a question. This would apply in the field as well as in the base hospital, and would prove an invaluable aid not only in detecting misfits and casualties suitable for discharge, but in detecting also those who may be returned to duty, as fitted still to serve the guns.



VISUAL EFFICIENCY AFFECTED BY SULFONAMIDES

Sulfathiazole or sulfadiazine was administered to 16 subjects in doses comparable to those used in the chemotherapeutic prophylaxis of gonorrhea (4.0 gm. in 24 hours), and the effect upon visual efficiency studied.

The administration of these drugs in small doses is not without untoward transitory effects upon visual efficiency. Ocular muscle balance for near vision and depth perception showed the most marked trend away from normal, but abduction and adduction also seemed somewhat affected. In a few subjects, the blind spot enlarged or the color fields constricted. Visual acuity and accommodation were not altered significantly.

The untoward effects upon muscle balance and depth perception were more marked and more persistent following the use of sulfadiazine than after corresponding doses of sulfathiazole. The latter drug, however, appeared to affect abduction and adduction, whereas the former did not.

The sulfonamide drugs should not be used indiscriminately, especially among those who constantly require maximum visual efficiency, whether in the armed forces or in civilian life.—Reynold, F. W.; Evans, M. S.; and Walsh, F. B.: Chemotherapeutic prophylaxis with sulfonamide drugs: I. The effect of small doses of sulfathiazole or sulfadiazine on visual efficiency. *Am. J. Syph., Gon. & Ven. Dis.* 27: 2-13, Jan. 1943.

CLINICAL NOTES

PELLEGRINI-STIEDA DISEASE ¹

MORRIS REINGOLD

Lieutenant Commander (MC) U. S. N. R.

and

JAMES W. NELLEN

Lieutenant, (MC) U. S. N.

In 1905 Pellegrini (1) and Kohler, independently of each other, described a calcification of the internal lateral ligament of the knee. In 1908 Stieda (2) reported six additional cases of this condition which has since been known as Pellegrini-Stieda disease. The first reference in the English literature to this subject appeared in 1932 (3). Since the first report of a case in this country by Kulowski in 1933 (4), about 73 additional ones have been reported in the English language. It is our impression that the disease is much more common than is generally believed, and that physical activity or trauma incident to military life may reactivate a supposedly quiescent lesion.

Eight typical examples of this condition have been observed in the course of 286 consecutive roentgenological examinations of knees at this hospital. These cases form the basis of this report.

ETIOLOGY AND PATHOGENESIS

The cause may be direct trauma to the region of the internal femoral condyle, or indirect trauma developing as a result of torsion of the knee during forcible flexion and abduction.

Several theories have been advanced to explain the development of the lesion. Among these are:

1. The extravasation of blood and synovial fluid into the internal lateral ligament with subsequent calcification (5).
2. A fracture with the detachment of a small particle of bone of the internal condyle of the femur with stimulation of calcification (2).
3. A metaplasia of connective tissue to bone (6) (7).
4. A periosteal tear with proliferation and formation of fractureless callus (8) (9).

In all our cases a clear space was demonstrated by roentgenograms between the internal femoral condyle and the calcified crescentic mass. For this reason we agree with the Millers (6), Oxford (7) and Kulowski (10), that the condition is not of periosteal origin, but rather a

¹ Received for publication October 19, 1942.

metaplasia of the soft parts with subsequent calcification. In this respect, it is closely akin to, if not the same process, that occurs in myositis ossificans.

DIAGNOSIS AND COURSE

The diagnosis depends on the roentgen examination of the knee, but the history, symptoms, and physical findings are fairly consistent. In all cases there is a history of antecedent trauma. This may be a direct injury, such as a blow on the medial aspect of the knee, or it may be indirect and of such apparently trivial nature, that the examiner may minimize its significance and consider it no more than a so-called sprain. Swelling occurs a few hours following the injury and persists for a period of a few days to months. The tenderness becomes localized to the medial aspect of the knee, generally after the effusion has subsided. It is only after a period of weeks or months, if at all, that the mass becomes sufficiently discrete to be palpable. There is an early limitation of motion of the knee, due mainly to the effusion; the restriction of motion that occurs later is apparently due to the lesion within the ligament itself. After a few weeks to months, the acute symptoms usually subside, to be followed by a period in which there are little if any symptoms referable to the knee. A superimposed injury at this time may cause a recurrence of the symptoms as was demonstrated in three of our cases.

It has been quite conclusively shown that there are no roentgen findings for at least 3 or 4 weeks following the injury. Consequently early roentgen examinations are of little aid in the diagnosis. Serial roentgenograms may reveal this lesion in cases in which the symptoms and physical findings of pain, tenderness, and restriction of motion persist for a length of time out of proportion to the nature of the injury.

The roentgen findings are characteristic and diagnostic. They consist of a crescentic, or roughly triangular shadow of bone density. This is situated in an oblique or more or less vertical plane running approximately parallel to the internal condyle of the femur and separated from it by a clear space. The calcification is of two types, producing either a mottled fuzzy indistinct shadow, called the "evolutive" and indicative of recent origin, or a clear-cut, sharply outlined deposit known as the "stabilized" form.

TREATMENT

For the most part the treatment of this condition has been inadequate and disappointing. Henson (11) reports good results after the operative removal of the calcification in one case. Kulowski (4), Riebel (12), and others have reported recurrence of calcification and

symptoms after surgical removal. Coltart (13) removed the mass in one case after which the symptoms were temporarily relieved, but recalcification occurred. In this respect the course is similar to that of myositis ossificans.

Some authors (14) report favorable results from conservative measures such as diathermy after a period of immobilization. This form of treatment was not successful in our hands but this may be because our cases represented reactivated lesions. Ritvo and Resnick (15), report four cases treated by physiotherapy as follows: Diathermy, chlorine ionization, radiant heat, massage and passive motion. These cases ranged from 7 weeks' to 4 years' duration with relief of symptoms, and in recent cases, complete disappearance of the mass. In two of our cases rather intensive roentgen therapy was used with no apparent effect on the course or symptomatology.

CASE REPORTS

CASE 1

History.—R. Z., male, age 27 years, was admitted to the hospital on January 9, 1942. He gave a history of having been struck on the right knee by a truck when he was 12 years old. This was followed by pain and swelling of the knee which persisted for several weeks. He did not recall what measures of treatment were taken at the time. Apparently, he had no further trouble until the day of his admission to the hospital, when he slipped on an icy surface striking the right knee. His only complaint was pain on the inner aspect of the knee.

Physical examination.—There was slight effusion in the knee joint. On palpation there was some tenderness on the medial side of the knee at the level of the femoral condyle. There was no laxity of the ligaments nor evidence of an injured meniscus. Extension was 165° and flexion to 100°.

Treatment and progress.—Infra-red radiation, diathermy and whirlpool baths did not relieve the symptoms. Roentgen therapy consisting of 6 weekly treatments were administered to the medial aspect of the knee. The following factors were employed: 140 kv, 5 ma, 3 mm. Al filter, 30 cm. distance 100 r (measured in air) at each treatment. Neither the pain nor disability were lessened appreciably. It was decided to give him a trial of duty on April 2. Two days later he returned to the hospital complaining of increased pain and swelling. On this admission he was discharged from the service by medical survey.

Comment.—Because of the sharply defined character of the crescentic calcification on the roentgenogram (fig. 1) it was felt that this represented a stabilized lesion of Pellegrini-Stieda disease beginning with the trauma that occurred at the age of 12, and that the lesion was reactivated by the trauma received as a result of his recent fall.

CASE 2

History.—H. J., male, age 27 years, was admitted to the hospital on October 30, 1941. He gave a history of having injured his knee in a football game in 1927, with subsequent pain and swelling for several weeks. Subsequent to that he did not have any disability and only slight pain on forcible flexion of the knee joint.

On September 8, while on maneuvers, he tripped and fell on his right knee. It has been continuously painful since and has interfered with the performance of his duties.

Physical examination.—There was a mild swelling of the knee, but no ballottement of the patella. On palpation there was tenderness along the margin of the internal condyle of the femur.

Treatment and progress.—Intensive physiotherapy consisting of radiant heat, diathermy and whirlpool baths did not afford relief. Two roentgen treatments as outlined in the previous case gave some relief, and he was discharged from the hospital on November 22 as improved. Four months later the patient was admitted to another hospital with a recurrence of his symptoms. After a stay of 6 weeks, he was discharged from the Marine Corps on a medical survey.



1. TYPICAL CRESCENTIC CALCIFICATION OF THE STABILIZED FORM.

Comment.—Because of the history, and the roentgen findings of a stabilized calcification of the internal collateral ligament (fig. 2), we may again assume that this is another instance of the reactivation of an old Pellegrini-Stieda disease.

CASE 3

History.—W. C., male, age 23 years, was admitted to the hospital on June 3, 1941. He gave a history of having his right knee injured in a football game in 1938. He stated that the injury was of a twisting nature while his knee was bent. There was pain and swelling of the knee for several weeks following the trauma. He had no further trouble with the knee until one week before entering the hospital when he began to have pain in the knee, when "snapping in" on the firing line. This became worse until he was unable to flex the knee.

Physical examination.—There was marked tenderness over the lateral internal ligament of the right knee, but no definite mass could be palpated. Flexion of the knee was limited to 95°.

Treatment.—Infra-red therapy was applied to the knee and passive exercises instituted. Under this treatment flexion of the knee was increased to 120° but the tenderness did not subside.

Comment.—While the patient was being treated on an ambulant status, (assigned to light duty), he was transferred to another station, and we do not know the outcome of the case. The fact, however, that he has a stabilized lesion (fig. 3) which was apparently symptomless for a period of years only to be reactivated on indirect repeated trauma, makes us feel that he will have further pain and disability. This will probably be out of all proportion to the severity of any subsequent injury or stress which he may suffer.



2. STABILIZED CALCIFICATION SEPARATED FROM THE INTERNAL FEMORAL CONDYLE BY A CLEAR SPACE,

CASE 4

History.—H. L., male, age 21 years, was admitted to the hospital on September 10, 1942. He gave a history of having injured his right knee in 1938 in a football game when he was "blocked" from the side. The knee remained swollen and painful for a period of about 3 weeks, after which time the symptoms completely subsided. He injured the knee 1 year later, and since then the knee "locked" on four occasions. He joined the Marine Corps in January 1941, and in March began to have continual pain in the knee. In October, while on a hospital ship, the right medial meniscus was surgically removed. Since then there has been

no "locking" of the knee, but the pain along the inner side has persisted without any improvement. It was because of this pain that he was admitted to this hospital.

Physical examination.—There was a well-healed curved incision on the medial side of the right knee. A small tender, nonmovable mass could be palpated on the medial side of the knee at the level of the femoral condyle. Extension amounted to 170° , while the knee could be flexed to 135° .

Roentgen examination.—X-rays disclosed a well-demarcated crescentic calcification running parallel to, but separated by a clear space from the internal femoral condyle, typical of the stabilized form of Pellegrini-Stieda disease (fig. 4).

Treatment.—At present conservative measures are being carried out but so far there has been no improvement.



3. STABILIZED AND SHARPLY DEFINED LESION SEPARATED FROM THE INTERNAL FEMORAL CONDYLE BY A CLEAR SPACE.

Comment.—We feel that this case presents an illustration of a combination of lesions. The surgical procedure relieved the "locking" but the source of pain is, and always has been, the Pellegrini-Stieda disease.

CASE 5

History.—G. S., male, age 24 years, entered the hospital on June 30, 1942. He gave a history of having been struck on the right knee about 8 years ago. Since then the knee has "buckled" and "locked" on three occasions. He enlisted in the Marine Corps in March 1942 and had no trouble until a week prior to his admission to the hospital, when he stepped into a hole and twisted his knee. The knee locked, but by sitting down and manipulating it he was able to straighten it out.



4. SMALL STABILIZED LESION ASSOCIATED WITH DISLOCATED ME
THE REMOVAL OF WHICH DID NOT RELIEVE THE PAIN OVER
CONDYLE.

Physical examination.—The patient walked with a limp. The into the knee joint with tenderness on palpation along the jo antero-medial compartment.

Roentgen examination.—X-rays revealed a sharply defined cre body, running parallel to but separated by a clear space from the i of the femur. It measured about 5 cm. in length and about 0. There were no articular or other periarticular changes (fig. 5).

Treatment.—The rather typical history, course, and physical displaced medial meniscus, made us feel certain that we were d latter condition as the prime cause for his disability. Accordin erated on July 7, and a torn, displaced medial meniscus was foun

Comment.—Since he has had complete relief of his symptom operation we feel that the Pellegrini-Stieda disease present wa cidental and not the cause of his disability. This is in direct cor Whether or not future trauma will cause a reactivation of his s time alone will determine.

CASE 6

History.—D. J. Mc., male, age 24 years, was admitted to t October 27, 1942. He gave a history of having been struck on left knee in a football game in 1937. It remained swollen and weeks. For the past 4 years he had no pain referable to his Oct. 26, while on maneuvers, he "hit the deck," striking his left not think that the trauma was very forcible. The following day, to pain and he noticed some swelling.



5. LESION NOT AS FULLY STABILIZED AS IN 4. THIS ALSO ASSOCIATED WITH TORN DISPLACED MEDIAL MENISCUS.

Physical examination.—There was some effusion in the joint. Tenderness was marked in the region of the internal condyle. There was slight limitation of flexion. A questionable mass was felt along the distal portion of the internal femoral condyle (fig. 6).

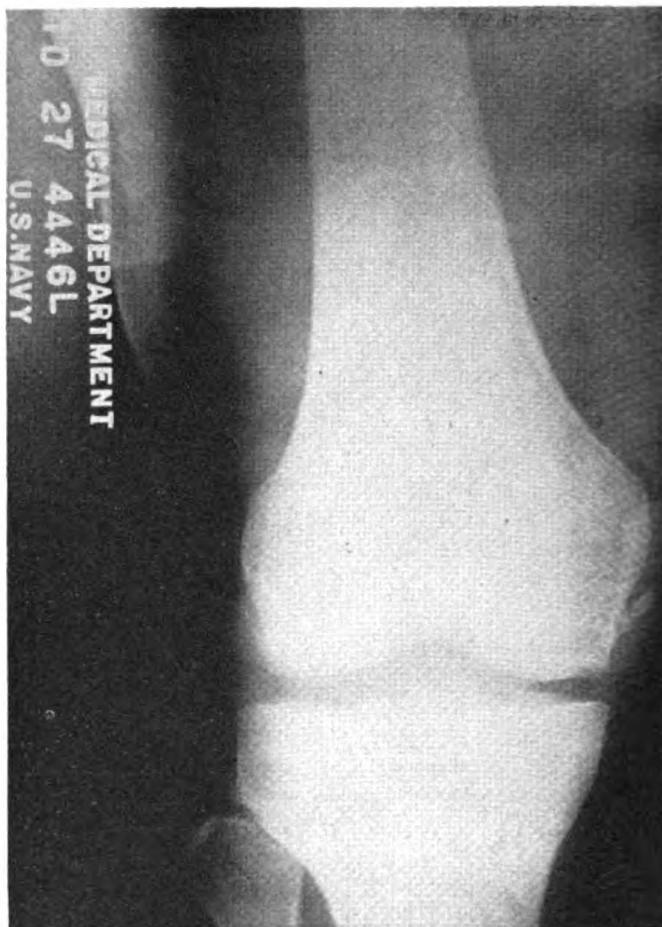
Comment.—This case is our most recent one and is still under treatment. It is our impression that the symptoms he presents are out of all proportion to the degree of trauma he received, and we feel that the symptoms of his old Pellegrini-Stieda disease have been reactivated.

CASE 7

History.—A. R. M. This case did not present any symptoms referable to his knee. During his physical examination for a commission, he stated that in 1935 he injured his right knee in a football game. His pain and disability was of such degree that his knee was strapped for 2 weeks and then placed in a cast for an additional 5 weeks. Roentgen examination at that time was negative. Because of this significant history a roentgenogram was made revealing a typical Pellegrini-Stieda lesion (fig. 7).

CASE 8

History.—W. C. S. As in the previous case, a roentgen examination of the left knee was made, when in the course of a physical examination for commission the applicant stated that he had two operations on his knee 15 years ago. At that time he fell from a tricycle, sustaining severe lacerations of the knee. Subsequently, they became infected, which necessitated two operations in three months, at which time he stated his "bone was scraped." Since that time, he



6. STABILIZED LESION OF THE DISTAL ATTACHMENT OF THE INTERNAL LATERAL LIGAMENT.

has had no pain or disability and had been able to play college football for several years.

Roentgen examination.—X-ray revealed a crescentic calcification in the region of the internal lateral ligament measuring about 2 cm. long and about 0.5 cm. in width. There was no clear space between the calcification and the internal condyle. Since there was a deep scar over this region, we assumed that the absence of the clear space could be accounted for by the bony changes following his operation (fig. 8).

SUMMARY

Eight cases of Pellegrini-Stieda disease of the stabilized form have been presented. In four of those cases the condition was re-activated by further trauma. In two of them, the pain and disability was severe enough to warrant discharge from the service by medical survey. The other three still have some pain and disability at the present time as far as we can ascertain. In two cases, the Pellegrini-Stieda disease was discovered when a routine radiographic examination was ordered after the applicants for commission



7. SYMPTOMLESS STABILIZED LESION.

gave a history of severe trauma to the knee, but denied any pain or disability since the initial injury. In one case the disease was merely incidental to a traumatized meniscus.

CONCLUSIONS

1. Post-traumatic calcification of the internal lateral ligament is more common than heretofore believed.
2. A supposedly symptomless stabilized lesion may be reactivated by further trauma.
3. These lesions may be complicated by injuries to the menisci, and therefore require great care in the choice of cases for the operative removal of semilunar cartilages.
4. Where there is a history of an old injury to the knee at the time of enlistment in the military service, and the history reveals

that the subsequent pain and disability was out of all proportion to the severity of the trauma, roentgenograms may reveal the presence of a Pellegrini-Stieda disease.



8. "SYMPTOMLESS" STABILIZED LESIONS ASSOCIATED WITH BONY CHANGES OF A HEALED OSTEOMYELITIS.

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ABDOMINAL APOPLEXY

REPORT OF A CASE

HARRY HALPRIN

Lieutenant Commander (MC) U. S. N. R.

In reviewing the literature on the subject of abdominal apoplexy, we find 20 cases of the syndrome reported over the period of years from 1909 to 1940.

It is important not to look at abdominal apoplexy from the point of view of a museum-type case. It is a problem of an acute intra-abdominal lesion, i. e., spontaneous rupture of an intra-abdominal sclerotic artery which, when diagnosed and localized, should be sought for and ligated, therefore giving the patient a chance for prolongation of life.

All reports agree that without surgical interference, they die. Sixteen of the 21 cases reported were operated upon. Of these 16, 11 patients recovered. Of the 5 in which operations resulted in death, 4 were cases in which no definite bleeding point could be found. A correct clinical diagnosis was not made in a single case of all those so far reported. Our case is no exception in that, but if coming in as a close second is of importance, it might be said that we definitely stated on the second day after admission of the patient, "that this case is one of a bleeding vessel at or near the pylorus." This statement however, due to our own lack of conviction, could not be backed up with enough positive proof to excite the surgical service.

CASE REPORT

History of present illness.—July 20, 1942: R. B. S., while attending the movies, experienced a sense of weakness, dizziness and inability to move. With the

help of his wife and daughter he returned home. Next day he developed a peculiar difficulty in speech, characterized by inability to get started rather than a motor dysfunction. At the same time he noticed weakness in the right arm. Four days later the weakness turned into numbness and tingling in right arm and leg. His speech became much thicker and "felt like a potato in his mouth." BP at this time was 230/140. One day after onset of this condition the patient began to vomit and was unable to keep much in his stomach. After swallowing he would feel a peculiar tightness in the abdomen. This was accompanied by vomiting. He suffered no severe pain with this condition. Two and one-half days later a tightness or binding sensation was noted in his chest, associated with marked difficulty in filling his lungs. It was necessary to try two or three times before getting his breath. Several hours later he developed crampy abdominal pain from the midline in the epigastrium to the symphysis. This pain was intermittent and did not interfere with sleep. It radiated into both lower quadrants. At the onset of this pain he developed palpitation which soon disappeared.

Physical examination.—From the physical findings of hypertension, neurologic findings, sclerotic vessels and urinary findings plus eye ground findings, his symptoms could be explained on the basis of terminal phase of malignant hypertension with cerebral angiospasm.

July 22.—Patient was improved yesterday and was removed from the serious list. Last night he developed a severe pain in right upper quadrant of the abdomen which has persisted and is only partially relieved by morphine. Patient has a large amount of gas and is nauseated but no vomiting. From the onset the pain has been typical of biliary colic, but the duration and the fact that it was not relieved by morphine and atropine makes one feel that it is a vascular lesion, intra-abdominal, possibly a dissecting aneurysm. At present his abdomen is soft. No masses or organs are felt, but there is intense tenderness in right upper quadrant, and the patient is bringing up large amounts of gas.

July 23.—X-ray of abdomen: A-P film of the abdomen and a P-A film of the gallbladder region shows no definite evidence of opaque calculi in the biliary tract region. However this entire area is obscured by gas and feces. The pain is not as severe as yesterday, and is inconstant. The rigidity is less but there is marked tenderness on deep palpation in entire right upper quadrant. Heart is fair, regular with roughened 2nd sound at apex. BP 175/115. Patient vomited a small clot of blood, 1 ounce. It appears that the condition may be due partially to pylorospasm with bleeding in the pyloric mucosa, due to perhaps minute thrombi or congested areas, or from a bleeding mesenteric vessel at or near the pylorus.

July 31.—R. B. C. 3,970,000 Hb 11.5 gms. 74%, W. B. C. 23,300; bands 6; segs 78; lymphs 16.

August 1.—Kahn negative.

August 4.—Chest tap done. Twenty cc. bloody fluid withdrawn from right side. Laboratory examination: Lymphs 98; polys 2. Few pleural cells. No tumor cells. Smear and culture, no growth after 96 hours' incubation.

August 10.—X-ray of chest: Film of the chest shows no evidence of infiltrative areas in the lungs. The cardiac and diaphragmatic shadows are normal in appearance.

August 17.—Patient complains frequently of strange, sharp, transient, generalized abdominal pain which at times awakens him from sleep. There is no abdominal spasm whatever but considerable tenderness above upper abdomen. Patient seems quite bright.

September 3.—Another attack of right upper quadrant pain last night. Feeling better this a. m. Still tender with some rigidity in right upper quadrant and along midline of abdomen.

September 7.—Pain free since September 3. Only slight tenderness right upper quadrant and both lower quadrants.

October 16.—Coughing up small clots of red blood since 6 a. m. BP 220/140. Pain is a dull ache in the lower right abdomen, radiating down both legs. Sputum negative.

October 30.—Last night another attack of pain, mostly lower abdominal, with radiation to both lower extremities.

October 31.—At about 2100 condition seems definitely worse, breathing shallow, pulse weak, color poor. Perspiring profusely, cold, clammy, very anxious expression, cannot talk, pulse 140, weak. BP 200/140.

November 1.—Became gradually worse during the night and was pronounced dead at 0340.

DIAGNOSIS: Hypertension; Intra-abdominal hemorrhage.

AUTOPSY

Peritoneal Cavity.—It contains about 3,500 cc. of liquid and clotted blood. The clots are located in the left upper quadrant and in the gastro-colic and greater omentum. Here this clot is unmeshed and quite firm and partially organized. Careful dissection of the blood vessels in this area (the right and left gastro-epiploic arteries) fails to show any site of rupture or perforation. It is felt however that it is in one of the gastro-epiploic arteries or in one of the branches that the point of bleeding is located. Several small clotted areas cover these branches. Mesentery is negative. * * *

Stomach.—Mucosa is negative. No ulcers present. Along the greater curvature is a mass of blood clot in the gastro-colic omentum as described above. Duodenal mucosa is red. Jejunum, ileum, appendix and colon are negative except as they are involved in liquid or clotted blood on their surfaces. * * *

Blood Vessels.—Aorta shows moderate arteriosclerosis and contains two mural thrombi each measuring 1 cm. in diameter. They are in the abdominal aorta and do not cover any vascular orifices. Exploration of the aorta from the aortic valve to the bifurcation fails to reveal any aneurysm.

Arteriosclerosis is freakishly selective in its distribution and its manipulation. It is not known why the large arteries are chiefly affected in one individual and the smaller arteries in another; nor why the patchy distribution of sclerosis in an artery. We cannot explain the varying degree of involvement of certain arteries in patients with identical findings. With the same degree of hypertension in both, we can only guess why one patient develops cerebral apoplexy and another angina pectoris.

The morbid anatomy of abdominal apoplexy differs from that within the brain, although both depend upon degenerative intramural changes from altered vessel circulation in sclerotic arteries. Aneurysm in the abdomen is rarely miliary, and hemorrhage from rupture of a large aneurysm is not considered apoplexy.

The heart is incapable of raising blood pressure sufficiently high to cause rupture of a normal artery. With loss of elasticity from

sclerosis, an artery becomes larger, thicker and harder. That weakness and increased vulnerability follow compensatory thickening of the arterial wall is a paradox, explained by the degenerative softening of atheromatous plaques or patches of lipoid material, which, forming sometimes even within the deeper layers of the wall, extend into the lumen of sclerotic arteries. In a new conception of the biology of arteriosclerosis, Winternitz and his co-workers have shown that the plaques are the results of nutritional degenerative changes from impaired mural blood supply, through the vasa vasorum. Ischemia from obstruction or oozing of blood into the wall from rupture of the vasa vasorum precedes atheromatous degeneration and necrosis.

Intramural hemorrhage, if extensive, may become a dissecting aneurysm. If slight, a forerunner of atheroma, the atheroma patch tends to liquefy, to discharge into the blood stream and to leave an ulcer of varying size and depth. Although calcareous salts may be deposited in the thrombin which forms over an ulcer base, if the integrity of the wall is sufficiently impaired rupture of the artery occurs. Degeneration and necrosis may extend into the media; leaving only a thin layer of musculo-elastic tissue under the adventitia. The atheromatous ulcer is a pathologic entity whose importance as a cause of thrombosis or embolism and of spontaneous arterial rupture is not yet appreciated by clinicians. As pointed out by Cushman and Kilgore in *Annals of Surgery*, October 1941, an analysis of the cases and a review of the literature will help to develop a syndrome which may be sufficiently clear to permit clinical diagnosis.

I submit the following suggestive cardinal points:

1. Most common in the male.
2. In the middle fifties.
3. Evidence of arteriosclerosis.
4. Well-marked hypertension.
5. History shortly preceding the onset, of some minor, perhaps insignificant, incident of strain or injury.
6. Pain, sudden, pulsating or throbbing, deep-seated, dull, aching, sickening, persistent in spite of heavy dosage of morphine. Subsides after several hours, only to return in few days.
7. Vomiting, usually without nausea.
8. Absence of definite point of tenderness.
9. Complete absence of muscle spasm.

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MECHANISM OF SULFONAMIDE ACTION

Clinically, it has been demonstrated that the sulfonamides exert their greatest effectiveness in pneumonia when they are administered early in the course of the disease. Although the precise mechanism through which these drugs exert their action is not completely defined, we do have, as a result of laboratory studies and clinical trial with the sulfonamides, some understanding as to the nature of the phenomena.* Reduced to simple terms, the most plausible explanation of their action is as follows: Bacteria must have proper nutriment in order to multiply and, apparently at some stage of bacterial reproduction, a nutritive factor, similar in basic chemical structure to the sulfonamides, is required. This nutritive factor has been shown to be para-aminobenzoic acid, although other substances may well play similar roles. Therefore, should the bacteria be unable to distinguish between para-aminobenzoic acid, which is essential, and the sulfonamides, which have no nutritive value, the organisms cease to multiply and finally meet destruction.—Flippin, H. F.: Causes for unsuccessful sulfonamide therapy of pneumonia. *South. M. J.* 36: 219, March 1943.

INTRA-ABDOMINAL INJURIES FROM DEPTH CHARGE BLASTS ¹

RAYMOND G. JACOBS
Lieutenant Commander (MC) U. S. N. R.

To a medical officer in the war zone there is nothing that gives a greater feeling of such utter incompetence as when attempting to care for these intra-abdominal injuries that arrive 16 to 18 hours after the initial concussion. Our cases, from a sea battle in the Solomon area, were subjected to depth-charge blasts, and exposed to salt water, tropical sunshine, and fuel oil for the next 14 to 16 hours. They arrived here after an additional 4-hour boat ride.

On our surgical ward we had 12 cases that could be classed as intra-abdominal injuries. Clinically, four of the twelve had the appearance of a developing peritonitis from intestinal perforations. The other eight presented a picture of abdominal wall and visceral contusion rather than perforation.

Of the four peritonitis cases, one had marked distention. The other cases either had no or very moderate distention. These cases had severe abdominal pain requiring morphine for relief, and the entire abdominal surface was uniformly rigid and extremely tender. Auscultation revealed a silent abdomen. Of the group of four cases, three, or 75 percent, of those we suspected having an intestinal perforation died.

Case 1.—This patient was not distended; he died in 24 hours. He did not respond to shock therapy and was unconscious the entire duration. His abdomen was boardlike in rigidity. Examination after death revealed large amounts of free gas, feces, and blood in the peritoneal cavity. The entire large and small intestines were deflated, and the intestinal wall was edematous, black and blue from hemorrhage and thrombosis. The sigmoid was intact, but the transverse colon was a sieve with holes that easily admitted 1 and 2 fingers. The wall of the cecum and ascending colon was very thin but not perforated. The distention was so great as to split the parietal peritoneal reflection a distance of 8 inches at the right parietal-colic sulcus. There was an incomplete transverse laceration at the ileojejunal junction over the lumbar vertebrae. This laceration and type of lesion strongly suggested a stretching across this hard barrier from the compression of the abdominal wall, resulting in the tear.

Case 2 died on his fourth day and we all agreed that his refusal to remain in bed was a factor resulting in his death. After 48 hours his abdomen was relaxed and he had no pain. To "gain strength" he insisted upon getting up and did walk around considerably. He suffered no ill effects until he had a slight fall and then developed pain in his abdomen. Twelve hours later he vomited blood

¹ Received for publication January 2, 1943.

and suddenly expired. Examination revealed multiple small perforations that had walled themselves off with omentum and knuckling. There was gas and feces in his abdomen and also a large amount of blood from torn mesenteric vessels. The intestinal walls likewise were black and blue from hemorrhage and thrombosis.

Case 3 died on his tenth day. His clinical course was definitely peritonitis with perforations from the very onset. He experienced a sudden abdominal pain 5 minutes after the blast. His resistance was remarkable as was his cooperation. He was given glucose 1,000 cc. with 2 ampules of sodium sulfapyridine monohydrated intravenously and morphine. His white blood cell count never went over 11,000 and his temperature was only 102° F. on his last day. Autopsy revealed the abdominal cavity filled with blood, gas, and feces. There were large perforations in the transverse colon, black and blue discoloration of the intestinal wall with what appeared to be areas of necrosis. His resistance was truly astonishing.

Case 4 in this series was an exact duplicate of our second death case. He had distention, tenderness, rigidity and a silent abdomen. But he was 100 percent cooperative and he gradually improved and recovered entirely. The abdominal tenderness remained for about 2 weeks.

The remaining eight cases did not present symptoms strongly indicative of perforation but more those of contusion to the abdominal wall and viscera. The patients were comfortable after 72 hours and recovery was rapid. They were given morphine for pain, and prostigmine every 4 hours. All cases that were received passed mucus and blood for about 3 or 4 days. Some had a siege of diarrhea. Four cases had a bluish discoloration over the recti muscles.

The common experience of all from the blast was a feeling of having their feet and legs torn from their body. Three men experienced a sudden abdominal pain 5 minutes after the blast. Of these two died and the other recovered. Apparently these abdominal cases were not in too great discomfort while floating in the water, but the 4-hour ride to the hospital was a painful experience. Two of the men who died were able to aid poor swimmers to rafts and did not realize the seriousness of their own injuries.

Of this series of 12 cases of abdominal injury 3, or 25 percent, died; but these 3 were all comprised in the group which presented clinical evidence of intestinal perforation. We feel that one of these four, case 2, should have survived had he complied with ward discipline. This would have given this group only a 50-percent mortality.

The treatment of these cases of intestinal perforation is difficult indeed. Had we operated on all four cases of suspected peritonitis I am convinced that our mortality would have been 100 percent. At 18 hours after injury the optimum time for surgical intervention had long passed. I do not believe in subjecting them to the discomfort and pain of anesthesia and surgery. However from the findings after death of gas in the abdomen without intestinal distention, it might be advisable to give relief from this stretching of the abdominal wall by

placing a section of a rectal tube through a small incision. This could be done under local anesthesia without moving the man from his bunk.

Furthermore, I believe that if these cases could be removed to a suitable operating room (and the facilities on a destroyer in combat are not satisfactory for obvious reasons) within 2 hours, an immediate exploratory with simple and rapid transverse closing of the perforations, washing out of the free intestinal contents, and powdering with sulfon drugs should be done. In transit to the hospital nothing can be done except to give morphine for pain.

SPONTANEOUS RUPTURE OF THE KIDNEY ¹

A CASE REPORT

F. GLENN IRWIN

Lieutenant Commander (MC) U. S. N. R.

The literature contains records of many cases of traumatic rupture of the kidney, but relatively few reports of spontaneous rupture. As Mathe ² in his masterful description of this subject pointed out, spontaneous rupture occurs in kidneys which have been weakened by chronic nephritis, stone formation, tuberculosis, abscess formation, tumor, infarct, pyelonephritis or aneurysm.

In the event that the rupture occurs through the parenchyma an extravasation of blood finds its way into the perirenal space and is confined to this space by the perirenal fascia, or finds its way into the renal pelvis or the peritoneal cavity. If the rupture occurs, however, through the pelvis or a major calix, urine extravasates into the renal fossa and is followed by abscess formation.

The literature on this subject was ably summarized by Mathe in 1932 at which time he presented five cases of his own and described the signs and symptoms, differential diagnosis, and treatment.

The following case is unusual in that the presenting symptoms and primary findings were those of hemoperitoneum of unknown cause.

CASE REPORT

H. A. H., gunner's mate, third class, USNR, age 25, was brought to the U. S. Naval Hospital, Treasure Island, by ambulance with the diagnosis of ruptured peptic ulcer.

Chief complaint.—Severe pain in the upper abdomen of 2½ hours duration.

Past history.—He had always been well.

¹ Received for publication January 30, 1943.

² Mathe, C. P.: Spontaneous rupture of the kidney. *Urol. & Cutan. Rev.* 36: 605-614, Sept. 1932.

History.—Ten days prior to admission he developed vague abdominal distress shifting from the right upper quadrant to the right lower quadrant and later to the right lumbar region. Urinalyses were done and no abnormal findings were noted. He was restored to duty and felt entirely well until 2½ hours before admission, at which time he was awakened from sleep by what he called an “explosion of pain” in his abdomen, followed by vomiting and collapse.

Later questioning failed to reveal any symptoms referable to the genito-urinary tract except that after drinking beer he occasionally experienced a vague ache in the region of his right kidney.

Physical examination.—Examination revealed a healthy, adult male, with normal temperature, pulse of 72, blood pressure 165/105. The abdomen presented a boardlike rigidity especially above the level of the umbilicus, with maximum tenderness in the central area of the epigastrium. There was no distention present and peristalsis was inaudible. The examination revealed no other abnormal findings.

Laboratory findings.—There was a leukacytosis of 14,700 with a shift to the left in the differential count. The erythrocyte count was 4,000,000. Urinalysis showed a trace of albumin and an occasional red blood cell in the sediment.

Working diagnosis and exploratory operation.—The preoperative diagnosis of ruptured peptic ulcer was made by the surgeon on watch, who recorded that at exploratory incision the entire upper abdomen was filled with unclotted blood as was the lesser omental cavity. The stomach and duodenum were examined and no perforation found. The source of the bleeding could not be determined and because of the poor condition of the patient the wound was closed with drainage.

Second operation.—During the following 6 hours in spite of parenteral fluids the patient's condition became slowly more precarious. For this reason the patient was again taken to the operating room and the original right rectus incision was enlarged. The patient was given continuous transfusions during the procedure. The entire right renal fossa was found to be enormously distended with coagulated and free blood displacing the right colon mesially to the midline. Through the hepatocolic ligament an opening was made in the posterior peritoneum and the coagulated blood removed. An opening 8 cm. in length was then visible in the anterior surface of the cortex of the right kidney. The kidney was rapidly mobilized and removed. A small portion of the kidney pelvis and the ureter were not dissected free or removed, as the patient's condition did not warrant it. Five grams of sulfanilamide were placed in the renal fossa and a stab drain brought out through the lumbar region. With transfusions, parenteral fluids and adrenal cortex extract the patient recovered from the associated operative shock and made an uneventful recovery.

Pathological report.—Gross examination: Specimen consists of a formalin fixed right kidney weighing 210 grams and measuring 14 cm. by ½ cm. Both fatty and renal capsules are absent. On the anterior surface of the cortex there is a break in the continuity measuring 8 cm. in length. The edges are frayed and covered by blood clots. In the vicinity of the apparent rupture are a number of small hemorrhagic areas extending into the cortex and grossly resembling small angiomata. The rupture leads into a dilated pelvis containing considerable blood clots. Both the major and minor calices are considerably dilated and small amount of blood clot is adherent to lining epithelium.

Microscopical examination: Microscopic study shows marked interstitial hemorrhage, and infiltration by round cells and fibroblastic cells occasionally occurring in small clusters. Many of the glomeruli are completely obliterated by red cells while others are partially filled or intact. The tubular cells show

some granular degeneration and many are filled with red cells or hyaline material. Occasionally the small vessels show some internal thickening, and a few are totally occluded. At the point of most massive hemorrhage the tissue is frayed and necrotic. There is no evidence of giant cells or of granulomatous formation.

Histopathological diagnosis.—Pyelonephritis, chronic; rupture, pathologic.

Intravenous pyelographic study made 4 weeks postoperatively showed good excretion from the left kidney, with pelvis, calices and ureter appearing normal. Kidney function tests with neo-lopax and indigo carmine indicated a normally functioning left kidney.

COMMENT

Nontraumatic hemoperitoneum in the male is unusual, and spontaneous rupture of the kidney as its cause is justifiably confusing to the general surgeon, who is perhaps not as "kidney-minded" as he should be. In traumatic or nontraumatic rupture of the kidney immediate surgical intervention is always indicated, and for this reason its possible occurrence should be kept in mind. Surgeons exploring the abdomen following blast injuries would do well to include examination of the kidneys when the source of intraperitoneal bleeding is not readily explained.



A LIGHT, COMPACT UNIT FOR THE INTRAVENOUS OR INTRA-OSSEOUS INJECTION OF PLASMA IN EMERGENCIES

Price presents a simplified apparatus for injecting plasma rapidly into the acutely disabled patients.

The unit filled and packed for transit weighs $1\frac{1}{2}$ pounds and measures $8\frac{3}{4}$ by $2\frac{5}{8}$ inches. It consists of syringe-needle and two flask containers.

Two techniques are described, one for intravenous administration of plasma, the other for intra-osseous. The simplicity of the mechanism, light weight, small size, rapid utilization, and choice of two routes of administration suggest that these units may be used with advantage by mobile groups or isolated personnel, thus giving the benefits of plasma to individuals at critical times under adverse conditions.

The ease of break-down, assembling, and sterilization enhances the utility of the unit.

It may be used for emergency injection of other substances such as human albumin, sulfa drugs, etc.—Price, A. H., and Tocantins, L. M.: A light, compact unit for the intravenous or intra-osseous injection of plasma in emergencies. *Ann. Surg.* 117: 152-158, January 1943.

IMMEDIATE TRANSFER OF PEDUNCULATED FLAP GRAFT TO PALM OF HAND¹

REPORT OF A CASE

RICHARD S. SILVIS

Lieutenant Commander (MC) U. S. N.

The hand is one of the most frequent sites of severe burns and of injuries with an avulsion of skin. The contracture of scar tissue on the hand will produce a far greater disability than a similar contracture on another part of the body. The occasions for skin grafts to the hand are not only relatively frequent, but they assume a proportionately high importance in the rehabilitation of our fighting men.

Defects on the dorsum of the hand can often be repaired by pinch grafts or split grafts. The palm, however, requires a tougher skin than that which results from these methods; therefore, a full thickness graft is indicated for palmar defects. Skin which resembles that of the palm occurs only on the other palm and on the soles of the feet, and cannot be spared from these sites. The skin may be obtained from the lower chest or upper abdomen, where the resulting defect can be immediately closed because of the plentiful supply of skin over these areas. A pedunculated flap, with a full thickness of skin should be raised, and a minimum of subcutaneous tissue should be included, in order to prevent an excessive thickness of the graft.

The transfer of the pedunculated flap may be either immediate or delayed. The delayed method permits of observation of the flap for a period of 1 or 2 weeks to make sure that its blood supply is adequate before transfer. This delay, however, results in a longer period of partial disability of the patient, and exposes the flap to additional chance of infection. The only objection to the immediate transfer of a pedunculated flap is that of insufficient blood supply, and this danger can be obviated by an incision which is planned anatomically to conserve the blood supply of the flap. Less contracture will occur in the flap if it is transplanted immediately, thus resulting in a thinner graft to the palm. And since a smaller flap is required for immediate transfer, the plastic repair of the defect on the chest or abdomen is facilitated. The scar should be dissected completely from the palm immediately prior to the raising of the pedunculated flap. During the time required for raising the flap and repairing the resulting defect, the bleeding from numerous small vessels in the palm will cease, thus

¹ Received for publication December 17, 1942.

providing a dry site for the reception of the graft and eliminating the use of numerous ligatures.

CASE REPORT

History.—M. H. M., seaman second class, USN, age 18 years, was admitted to the sick list on October 23, 1942. He complained of a painful scar on the palm of his right hand, and inability to straighten the fingers. His hand had been severely burned on June 12, 1942, following which he was treated for 2 months in a hospital. His hand healed but a thick scar remained on his palm. He massaged this scar with mineral oil for 2 months, but the scar gradually contracted and the disability of his hand increased. At the time of admission he could not grasp or lift heavy objects, suffered a considerable amount of pain in his hand, and was unable to perform his routine duties.

Physical examination.—The physical examination was essentially negative except for a scar on the right palm. The scar was thick, contracted, and covered all of the palm distal to the hypothenar eminence and lateral to the little finger. This scar extended distally and covered the palmar surfaces of the proximal phalanges of the index and middle fingers. Extension of the metacarpophalangeal joints of the index, middle and ring fingers was limited to 150°. Laboratory examinations were negative.

Diagnosis.—Contracture, palm, right hand.

Surgical procedure.—On October 23, 1942, a light plaster cast was applied to the patient's chest, leaving a V-shaped aperture over the lower left chest. Several pieces of coat-hanger wire were incorporated in this cast and allowed to project one-half inch at right angles, to be used to anchor the cast on the right forearm later.

Under a wrist block anesthesia, using 1 percent procaine, the scar was completely dissected from the palm and from the index and middle fingers. Many bleeding vessels were temporarily clamped but only the three largest were ligated with number 00 plain catgut. A pressure dressing wet with 0.8 percent sulfanilamide in normal saline solution was applied to the palm. With the forearm in full pronation a light plaster cast was applied from the elbow to the wrist. Bent wire was incorporated in this cast in the same manner as in the cast on the chest.

Under a field block anesthesia, using 1 percent procaine, a pedunculated flap was raised from the left lower chest. This flap was directed medially, with its pedicle laterally, to insure its blood supply. Its margins were outlined with a small sterile steel ruler that had been used to measure the palmar defect, and all measurements were increased 25 percent to allow for contraction of the flap. The flap was covered with dressings wet with warm 0.8 percent sulfanilamide in normal saline solution. The resulting defect in the chest wall was closed by the H plastic method. Since the defect was irregular in outline, it was necessary to use a double H in this repair. The incisions were extended superiorly and inferiorly, and the flaps were raised and brought together and sutured without undue tension with interrupted vertical mattress sutures of number 30 white cotton thread. A rubber-dam drain was placed beneath these sutured flaps and was brought out through the lower lateral angle of the incision.

A dry sterile dressing was applied over the repaired defect on the chest wall, and the right forearm was brought across the chest. The pedunculated flap was sutured to the defect on the palm, using closely placed vertical mattress sutures of number 000 dermal on a fine needle. The flap was not cut between

the index and middle fingers. No attempt was made to suture the flap at the point where it crossed the lateral margin of the palmar defect. Three loosely tied sutures, parallel with the long axis of the flap, were placed to fix the central portion of the graft to the palmar fascia.

The cast on the forearm was fixed to the cast on the chest with plaster, utilizing the projecting wires to secure firm fixation with a minimum of plaster. The pedicle of the flap was inspected and seen to be under no tension. Sterile dressings were applied, and the distal ends of the fingers were incorporated in plaster and held in full extension (fig. 1). The patient was in excellent condition at the end of the operation, and walked from the operating table to his bunk in the ward.

Postoperative course.—The patient had a low grade fever of 99.6° to 101° F. normal. He was given multiple vitamin capsules twice daily, a regular diet, and was allowed to be up and about after the fifth day. Sulfathiazole was administered during the first four days, chiefly as a prophylactic against infection. The fever was believed to be due from absorption, since the dissection on the chest was quite extensive.



1. SHOWING FOREARM CAST AFFIXED TO CHEST CAST.

October 30, 1942.—Cutaneous sutures and drain removed. The flap was uniting to the palm by primary union, with no evidence of infection.

November 7, 1942.—The dressing was removed, and the flap was seen to be firmly healed to the palm. The pedicle was severed and the cast was removed. The palmar side of the severed pedicle bled freely, revealing an adequate blood supply to the flap. The cutaneous sutures were removed from the chest.

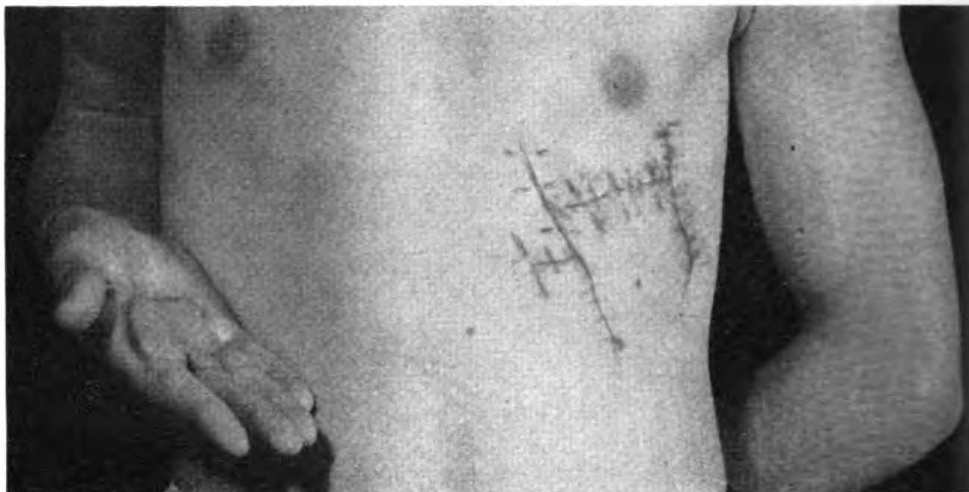
November 10, 1942.—Using a wrist block anesthesia of 1 percent procaine, the lateral margin of the graft was sutured to the palm. The portion of the graft running between the index and middle fingers was incised down to the interdigital web. The skin margins along the medial side of the index finger and the lateral side of the middle finger were freshened by the excision of granulation tissue, and the margins of the flap were sutured to them. The fingers were held in full extension by a basswood splint, which was applied posteriorly from the elbow to beyond the fingertips. A wire was placed through the distal end of the splint to suspend the hand when the patient was lying down; and when ambulatory the forearm and hand were carried in a sling.

November 16, 1942.—The cutaneous sutures were removed from the hand. Healing by primary union was complete except for an area 1.5 centimeters in length at the proximal end of the lateral margin of the graft. A cod-liver oil dressing was applied to this area.

November 26, 1942.—The graft was completely healed to the right palm, and full extension and flexion of the fingers without pain was possible. Under intercostal anesthesia, using 1 percent procaine, the lateral vertical scar on the chest

was excised, and the redundant portion of the stub of the pedicle was excised. The lateral two inches of the adjoining transverse scar was also excised. The incisions were closed without drainage and after the application of sterile gauze, tape was applied over tincture of benzoin compound to eliminate all tension from the suture lines.

December 3, 1942.—The cutaneous sutures were removed from the patient's chest. The incisions were healed by primary union, with no evidence of infection.



2. SHOWING END RESULTS.

December 5, 1942.—Discharged to duty this date. The incisions on the patient's chest are firmly healed (fig. 2). There is a moderate amount of scarring of the chest due to the fact that the plaster cast prevented the removal of the cutaneous sutures until the fifteenth day. The pedicle could probably have been severed on the tenth day with safety, but the gain involved would not have been worth risking the blood supply of the graft. There is no tenderness over the left chest, and the patient can take a deep breath without pain. The graft is firmly healed to the right palm, and the movements of the right hand and fingers are not restricted. The patient's grip is strong and he is able to grip irregular objects without pain.

SUMMARY

A case of contracture of the right palm was treated by the immediate transfer of a pedunculated full-thickness flap graft from the patient's left chest.

Surgical principles emphasized in this case are:

1. The immediate transfer of a pedunculated flap.
2. Firm fixation of the hand to the chest with plaster.
3. The use of a minimum number of buried ligatures.
4. The use of closely spaced fine vertical mattress sutures.
5. Immediate closure of defects resulting from the elevation of pedunculated flaps.

GENERALIZED ECZEMATOID DERMATITIS, ANGIONEUROTIC EDEMA, AND ANURIA FROM SULFATHIAZOLE

WARREN L. STROHMENGER

Lieutenant (MC) U. S. N. R.

This is a case report of sulfathiazole allergy produced by topical applications of sulfathiazole, with reactivation when the drug was taken by mouth.

The literature does not reveal any cases produced in quite the same manner, nor having all the conditions noted in this one case.

Dennie (1) describes three cases of angioneurotic edema and dermatitis venenata from the drug.

Burkland and Satterthwaite (2) found 9 cases of conjunctivitis in 8 patients in their series of 300 cases (2.8 percent) and 6 cases with skin reactions, 1 urticarial in type and the remainder maculopapular in character.

Lyons and Balberor (3) report febrile reactions accompanying the readministration of sulfathiazole by mouth. On the second course of sulfathiazole 19 of 53 cases (36 percent) showed severe febrile reactions; 11 of 36 (31 percent) received the initial course for therapeutic purposes and 8 of 17 (47 percent) were controls. The rise in temperature from 102° to 106° F. occurred on the first day of the second course and was accompanied by chills, profound prostration, weakness and exhaustion.

Urticarial, erythematous, macular, papular, nodular and purpuric eruptions were encountered in 3.9 percent in a group of 180 cases by Volini, Levitt and O'Neil (4).

CASE REPORT

On December 4, 1942, the patient was admitted to the sick bay because of second-degree burns of both hands from live steam. The hands were cleaned with soap and water, blebs were debrided under aseptic technic, and a mixture of 2 percent gentian violet and 5 percent sulfathiazole in a tragacanth base was applied.

Six days later patient was returned to duty, improved, still under treatment, with lesions dry and crusts firm.

December 23, with the crusts about all off, a jelly consisting of sulfathiazole 5 percent, carbamide (urea) 15 percent, allantoin 0.6 percent in a miscible base was applied because of some cracking of the new skin and denuded areas. It was then noted that the lesions began to weep. Because of the weeping, the next day sulfathiazole powder was used. The lesions became worse and on December 25 patient had angioneurotic edema of the face. Epinephrine in oil relieved the edema and all previous medication was immediately stopped. A

dermatitis venenata-like lesion of the right forearm and about the areas of the old burn appeared the next day. This was relieved by repeated applications of calamine lotion with $\frac{1}{4}$ percent phenol.



1. ANGIONEUROTIC EDEMA AND ECZEMATOID LESIONS OF THE FACE.

By January 8, 1943, the lesions were about healed when the patient (a hospital corpsman) had a sore throat and administered to himself 2 grams of sulfathiazole by mouth at 0800, and 2 grams more at noon. By 1300 he noted tingling of the hands, then general malaise, "as though going down with the grippe." By 1500 he had an eczematous lesion of the face; areas formerly healed as well as those still open on the hands began to exude a serosanguineous exudate, his lips began to crack, eyelids became swollen and soon he had an intensely itching maculopapular rash over the remainder of the body. By 1630, his eyelids were so swollen that he could not open them, and he was beginning to have chills; he described these tremors as nervous twitching with no sensation of cold. He was nauseated but did not vomit. His temperature and pulse climbed rapidly. He did not void any urine after 1400 and was unable to do so, although repeated attempts were made, until 0400 the next day. His temperature and pulse then began to descend rapidly. The urine voided at that time showed a specific gravity of 1.028, cloudy, acid, albumin and sugar negative. There were several blood cells per high-power field, several granular casts and many crystals

found on microscopic examination of the urine. Blood count on January 8 showed red blood cells 4,800,000, white blood cells 8,900, segmented 64 percent, lymphocytes 27 percent, bands 5 percent, eosinophils 2 percent, juveniles 1 percent, and monocytes 1 percent. January 9, red blood cells 3,900,000, white blood cells 15,800 with polymorphoneuclear leukocytes 96 percent and lymphocytes 4 percent with no eosinophils. January 11, R. B. C. 4,400,000, W. B. C. 7,500 with segmented 65 percent, lymphocytes 30 percent, monocytes 2 percent, eosinophils 3 percent, with urine negative except for many red blood cells. January 12, urine negative except for several red blood cells. January 13, urine negative.

After the kidneys started functioning the temperature and pulse rate descended and the recovery was uneventful except that he noted a bilateral lumbar ache for 4 days. By January 18th the patient was recovered.

Upon questioning him as to previous allergies, he recalled having had a reaction to quinine as a boy.



2. ANGIONEUROTIC EDEMA AND ECZEMATOID LESIONS OF THE FACE. ALSO MACULOPAPULAR RASH ON ARMS AND DERMATITIS VENENATA OF THE RIGHT FOREARM.

SUMMARY

This patient developed his generalized eczematoid dermatitis, angioneurotic edema, and anuria directly after the oral administration of two doses of 2 grams each of sulfathiazole, 4 hours apart. This patient had had no previous sulfa drug of any kind except local application of sulfathiazole to the debrided second-degree burns of the hands which was applied 35 days before.

CONCLUSION

It is possible to become sensitized to sulfathiazole simply by superficial application on the skin without previous oral ingestion or local administration beneath the skin or into the vein.

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CEREBROSPINAL FEVER (MENINGOCOCCIC)

It is concluded * * * that the sulfa drugs are of value in prophylaxis of cerebrospinal fever (meningococcic). We never had a repeat case in any platoon (62 men) that had been given sulfanilamide. Further, at no time has the routine training been interfered with other than the 3 days that platoons were confined to barracks. They, however, carried on training as usual only with the elimination of outdoor work on the drill field. Thirdly, the fear of the disease both among officers and men was eliminated, and fourthly, as you will hear from the hospital the disease can be satisfactorily treated with the sulfa drugs alone, a great comfort particularly to the medical officer overseas.--Thomas, G. E., Captain (MC) USN: Memorandum on Medical Matters of U. S. Marine Corps Base, San Diego, Calif., October 10, 1942.

MEDICAL AND SURGICAL DEVICES

THE SURGICAL OPERATING SUITE IN THE NAVY¹

CARLTON L. ANDRUS

Captain (MC) U. S. N.

JAMES B. BUTLER

Lieutenant Commander (MC) U. S. N.

and

ALTON R. HIGGINS

Lieutenant Commander (MC) U. S. N.

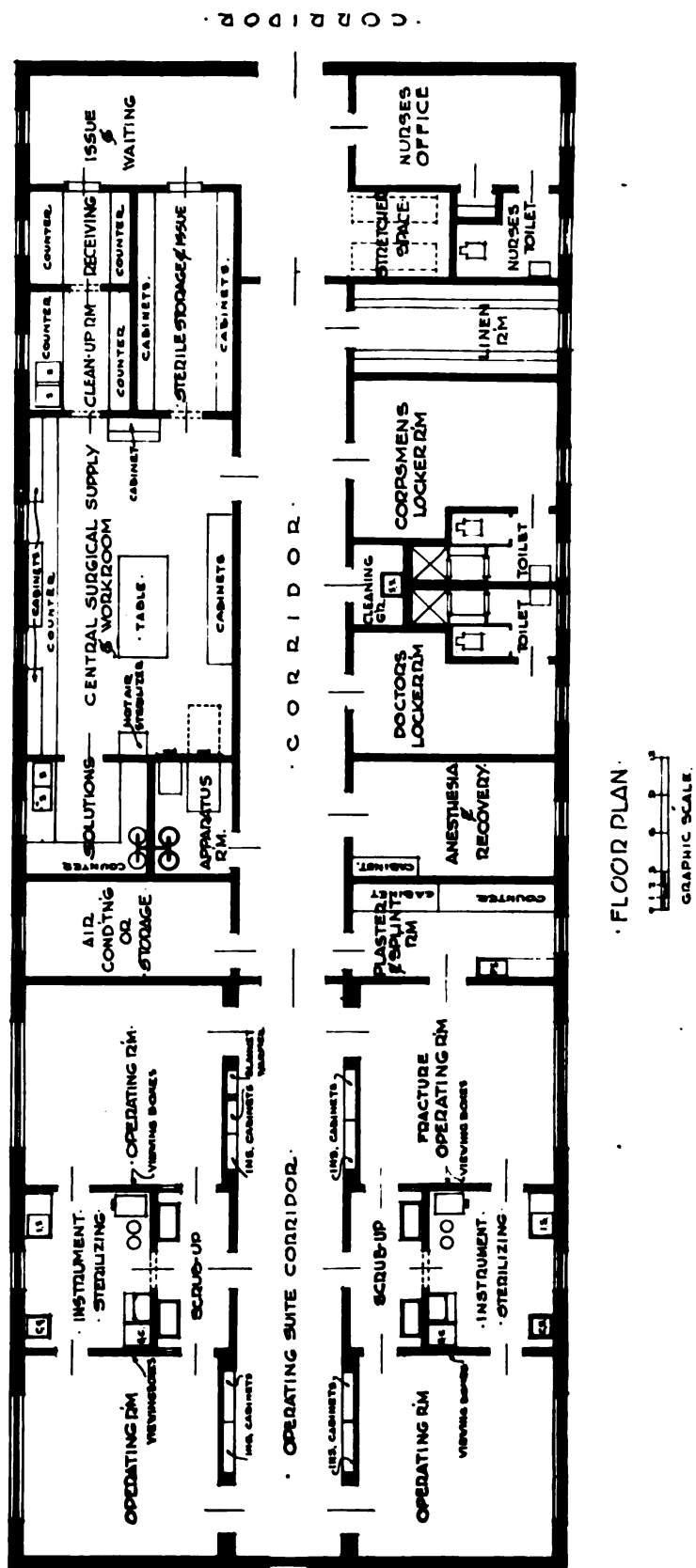
With the acceleration of hospital construction in the expanding naval establishment it became necessary to standardize certain departments in the construction of new naval hospitals. In developing the surgical facilities for these hospitals, the ideas and comments of a large number of surgeons in the Navy have been considered and an attempt has been made to express the best concepts in a standard surgical suite layout. Consideration was given to variables peculiar to different naval stations, such as climate, type of hospital service to be provided, type of construction, etc. It will be obvious that such a standard plan will not be ideally suited to meet the needs of all naval hospitals, and modifications may be necessary for adaptation to local situations. The standard layout discussed here is only applicable to hospitals on the order of 500 to 1,500 beds and is being included in such hospitals which are now, or will be, under construction (see fig. 1).

THE OPERATING AREA

In the matter of operating room design a marked divergence of opinion prevails. In general, the size of rooms and items of equipment which should be provided are points of major discussion. The minimum room size for a major operating room is apparently about 16 by 16 feet. The consensus as to equipment seems to be that as little equipment as possible should be located inside the operating room so that traffic will be eliminated when the rooms are not in use. Thus instrument cabinets, blanket warmers, and solution storage are located outside of the operating rooms.

A wide choice of materials is offered for room finishes and new materials are constantly being developed, some of which will be acceptable for use. In the standard suite, a tile or terrazzo floor

¹ From the Planning Division, Bureau of Medicine and Surgery.



1. SURGICAL SUITE AND CENTRAL SUPPLY DEPARTMENT, U. S. NAVAL HOSPITAL.

electrically grounded, has been specified. Marble or tile wainscot to 7 feet is commonly used and may be carried to ceiling height. Provision is made for air-conditioning equipment and present trends are to control temperature and humidity in the operating area by means of this equipment. It will be noted in figure 1 that the operating rooms only are within the air-conditioned area and that a reduction of temperature is provided elsewhere in the suite only when required.

An instrument-sterilizing utility room is located between each two operating rooms and is designed for immediate service to either operating room. Included here are a high speed pressure dressing and instrument sterilizer, instrument sink, clinic service sink, utility sinks, supply cabinet and solution storage cabinet. Scrub sinks are located between operating rooms and viewing windows are provided which permit the surgeon to observe conditions existing in the operating room while he is scrubbing up. It is important that passage into the scrub-up area and the instrument sterilizing area is possible without passing through an operating room. Thus there will be no reason to enter an operating room unless it is actually being used, and contamination will be reduced to a minimum.

It is intended that one or more operating rooms be designated for "clean" surgery, for "infected" surgery, or minor operative work as may be required to meet administrative needs.

Instrument cases and blanket warming cabinets are built-in and are opened from the corridor so that they are accessible outside of the operating rooms.

The space required for anesthesia and recovery rooms is variously estimated. It appears that with present-day methods of surgery in the Navy there is little call for these rooms and only one such room is provided.

The fracture operating room is equipped with an orthopedic operating table. Adjoining it is a splint room with work bench, work counter, and storage cabinets. A sink with a plaster trap is installed here and a portable minor surgical light is provided.

THE CENTRAL SURGICAL SUPPLY DEPARTMENT

In the development of design for surgical suites in recent hospital projects increasing attention has been given to the question of handling surgical supplies for the entire hospital. Several of the newer hospitals, notably the U. S. Naval Hospital, Philadelphia, Pa., and the National Naval Medical Center, Bethesda, Md., have included a central surgical supply department in the original plans. In working out a standard plan for this department the following objectives were considered:

1. Central custody, inventory and issue of all types of surgical supplies and equipment. All items are checked out on requisitions to other departments and are checked in on return. Thus it is possible to maintain inventory and to place responsibility for lost or damaged items.

2. Centrally supervised processing of all surgical supplies and equipment. This includes the cleaning, reconditioning and storage of surgical trays, packs, and instruments but does not extend to the processing of minor items such as hypodermic syringes, needles, or ward utensils.

3. Supervised sterilization of all surgical solutions, surgical supplies and equipment. The autoclave has been developed during the past few years to a point where it becomes a precision instrument. Where sterilization is divided among the various departments of a hospital it frequently becomes dangerously unsatisfactory. This highly technical procedure, for safe results as well as for instruction purposes, should be done under the supervision of one especially trained in this work. The advantages of such instruction for pharmacist's mates are obvious. The time-honored dictum "15 pounds for 15 minutes" is an anachronism.

The modern principles of sterilization and the correct operation of a pressure sterilizer are vital matters in the preparation of a hospital corpsman for duty aboard ship or on shore station.

In the plan discussed the central surgical supply department is included in the surgical suite for administrative convenience. Usually both will be under the supervision of the senior surgical nurse who is especially trained in this work. Study of the floor plan will show the coordination of receiving, processing, sterilization, storage and issue of surgical supplies and equipment. The flow of materials is that of the production line and economy of time and labor is attained. It will be evident that other arrangements are possible but the proposed plan is a combination of several excellent layouts.

The equipment shown in the various divisions of the central supply department is planned to fit the processing "production line."

The receiving room, where used equipment is returned and checked, leads into the clean-up room. Here all soiled glassware, instruments, etc., are washed and are then passed on into the workroom. In the workroom, needles are processed, gauze is cut, gloves are cared for, and special trays are reassembled. Recessed pressure sterilizers are arranged for bulk sterilization of supplies and are equipped with racks and cars for handling solutions and bulk supplies.

Following reassembly, labeling, and sterilization, solutions, trays, and supplies are placed in storage cabinets and kept on hand for issue on requisition to all departments.

It will be noted that an issue and waiting alcove is placed at the entrance to the suite so that personnel from other departments will not contaminate the operating area while drawing or returning supplies.

Efficiency in the operation of this suite will, in large measure, depend upon the administrative ability of the supervising nurse. With

the completion of the present hospital building program the surgical suite as herein described will be a component of many naval hospitals and dispensaries. As a result, the surgical suite and central surgical supply department will be familiar to personnel who are transferred from one activity to another and less time will be required for the indoctrination of personnel reporting at a new station.

THE SOLUTION ROOM¹

ALTON R. HIGGINS

Lieutenant Commander (MC) U. S. N.

and

HELYN LONG

Ensign (NC) U. S. N.

This equipment is treated separately for several reasons. A complex procedure, requiring highly skilled technicians, it has grown with the increasing parenteral use of surgical fluids. The economy of preparation of surgical fluids is perhaps debatable, but in a hospital of over 500 beds, as in this instance, it is generally conceded to be an economical process. The value of teaching such an exact technical procedure to hospital corpsmen is great.

Many types of solution-making equipment are available in the market, all having desirable features. The equipment described below is well adapted to the needs of the naval service, adequate for the purpose, uncomplicated, and easily replaceable. It would be highly desirable to standardize equipment of this type throughout the Navy so that shifting personnel might use it well. With some modification the equipment described will serve for blood plasma processing.

The solution room is arranged to coordinate the steps of manufacture as shown in figures 1 and 2. All parts may be taken down for cleaning after each day's work is completed. The solution-making glassware is cleaned by special methods and with special equipment detailed below. An explanation of the equipment and its use is appended.

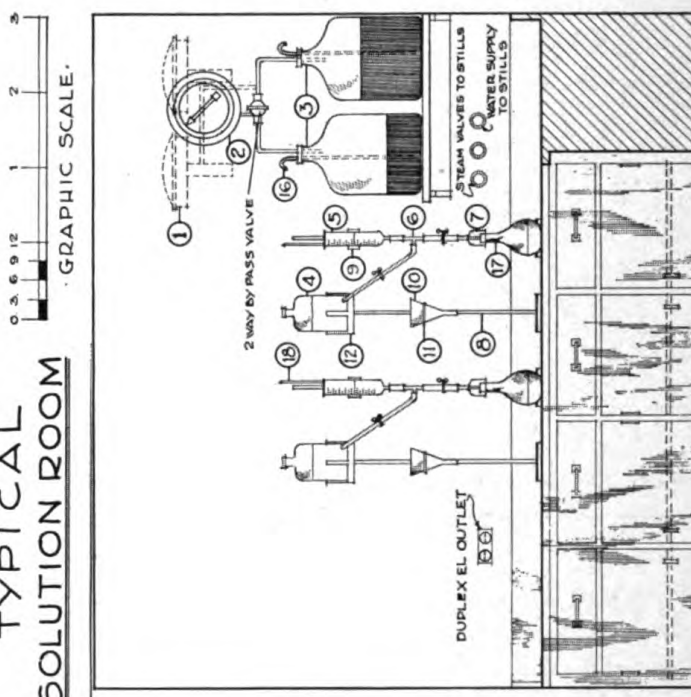
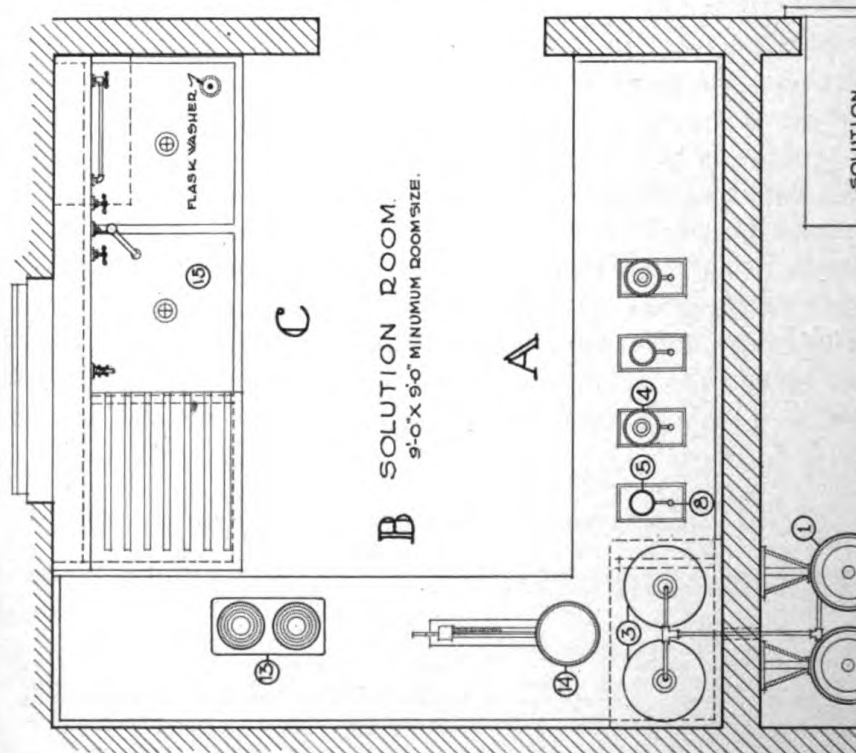
THE PREPARATION OF PARENTERAL FLUIDS

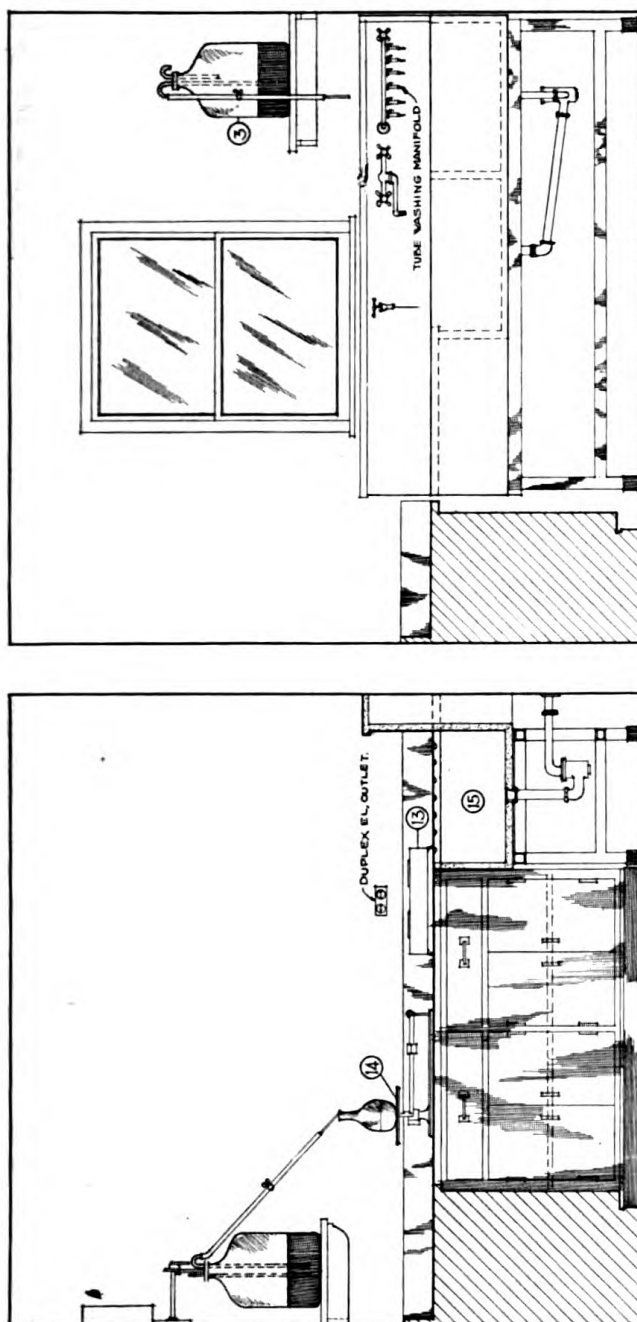
1. List of Equipment for the Solution Room.

- | | |
|---|--|
| 2 5-gallon per hour stills. | 4 large supports. |
| 1 electrical conductivity meter. | 2 5¼-inch ring supports. |
| 1 two-burner electric stove. | 2 support tables capable of supporting |
| 1 side-arm balance solution scales. | 2 liter aspirator bottles. |
| 1 double soap stone sink with multiple head faucet. | 4 clamps—large, ring stand, to hold
burettes. |

¹ From the Planning Division, Bureau of Medicine and Surgery.

EQUIPMENT & CABINETWORK IN A TYPICAL SOLUTION ROOM





ELEVATION-C

ELEVATION-B

FIGURE 2.

- ① Two 5-gallon per hour stills.
 ② Electrical conductivity meter.
 ③ Five-gallon bottle.
 ④ Aspirator bottle.
 ⑤ Dispensing burettes.
 ⑥ T. tube.
 ⑦ Filling attachment.
 ⑧ Large supports.
 ⑨ Clamps, large, to hold burettes.
- ⑩ Glass funnels.
 ⑪ Ring supports $5\frac{1}{4}$ " diameter.
 ⑫ Support table for 2-liter bottle.
 ⑬ Two-burner electric stove.
 ⑭ Side arm balance scale.
 ⑮ Double soapstone sink.
 ⑯ Syphon canes.
 ⑰ Solution bottles, special tops.
 ⑱ C. scale thermometer.

- | | |
|--|---|
| 4 clamps, Day's pinchcock. | 2 24-, 4-, 3-inch pieces pure gum rubber tubing. |
| 2 clamps, Mohr's pinchcock. | 1 pound lead foil. |
| 1 beaker tong. | 2 medium porosity ground glass filters. |
| 1 bottle brush. | 1 rubber stamp pad and rubber stamps of solutions being made. |
| 2 trays, aseptic, enamelware, 15" x 9¼" x 2½". | 1 box solution tags. |
| 1 centigrade scale thermometer. | 1 record book, pencils and scratch pad. |
| 4 two-holed rubber stoppers, size #12. | 1 framed copy of solution formulae. |
| 4 5-gallon pyrex bottles. | 1 roll wax paper and brown paper. |
| 2 pyrex glass syphon canes, ½" diameter. | 1 supply C. P. anhydrous dextrose. |
| 2 aspirator bottles, pyrex. | 1 supply C. P. sodium chloride. |
| 2 dispensing burettes, 300-mm., pyrex. | 1 supply dichromate of potash crystals. |
| 2 T tubes. | 1 supply T. P. sulfuric acid. |
| 2 filling attachments, pyrex. | 1 supply sodium carbonate. |
| 2 shell scoops. | 1 supply solution bottles and tops. |
| 2 25-pound glass storage jars, with lids. | 6 hand towels. |
| 1 pyrex stirring rod. | 1 supply paper towels. |
| 1 50-cc. syringe. | 1 bottle liquid soap. |
| 2 6-inch pieces glass tubing, pyrex. | 1 autoclave with carrier equipped with solution racks. |
| 1 rubber apron. | 2 gallon jugs with single and double-holed stoppers. |
| 3 beakers, 2,000-cc. capacity, pyrex. | |
| 2 pieces pure gum rubber to fit syphon canes. | |

2. Method of Preparation of Equipment.

Following assembly of above equipment, it is set up as shown in figure 1, after being thoroughly cleaned. The glassware is first treated as new equipment. It is thoroughly scrubbed with hot soapy water, well rinsed in tap water, filled with cleaning fluid and allowed to soak for 1 hour. Then the glass is rinsed six times with tap water, twice with distilled water.

The stainless steel flask cap is first thoroughly washed with hot soapy water, repeatedly rinsed in tap water, and twice in freshly distilled water and then placed in freshly distilled water until use.

The rubber bushings are first washed thoroughly in hot soapy water, boiled 1 hour in 5 percent sodium carbonate solution, washed again in tap water, boiled another hour in tap water, thoroughly rinsed with tap water and then twice with distilled water, and placed in freshly distilled water until used.

New rubber tubing is similarly treated. It is first well rinsed in hot tap water, then coiled into a gallon jug. An adapter is connected to the tubing through a single-holed, tight stopper, and the jug is filled three-quarters full of 5 percent sodium carbonate solution. The first jug is then connected with an empty gallon jug with a two-hole stopper, one hole of which is a vent.

Both jugs are placed on solution racks and autoclaved for 20 minutes, then pressure is slowly exhausted. The jugs are left in the autoclave for one-half hour after opening the door. The fluid will

have been pumped into the empty jug. On removal from the autoclave the tubing is rinsed on a multiple head faucet for 3 hours, then coiled back again into the jug and the same procedure repeated, using tap water in lieu of sodium carbonate solution. The tubing is now rinsed 30 minutes on the faucet, and a liter of freshly distilled water run through before it is drained and sterilized. The above process is recommended for new rubber tubing, and tubing which has been used for blood, sulfa drugs or other chemicals. For routine cleansing of tubing used for saline or glucose-saline, tap water washing followed by distilled water rinsing will be sufficient.

With all the pieces of equipment chemically cleaned and set up, the stock solution is made up from chemically pure anhydrous dextrose, chemically pure sodium chloride, and freshly distilled water, and filtered through medium porosity ground-glass filters. The flask is then placed on the solution scales, counterbalanced, tagged, and into it from the dispensing burettes is run the correct amount of stock solution. The remainder of weight is made up by adding freshly distilled water. An allowance of 5 percent of solution is made for loss during sterilization. The solution bottles thus prepared are now loaded in the autoclave carrier, sterilized, sealed, and then stored until issue.

The above brief description of the preparation of parenteral solution is intended, not as a detailed text, but as an explanation of the use of the equipment shown. It is assumed that the preparation of these fluids will be handled only by those having special knowledge of this phase of surgical work.

A MOBILE SURGICAL UNIT

DAVID J. CRACOVANER
Commander (MC) U. S. N.

Much has been said and written about the character of "modern warfare," its dynamism, its mobility, its fluidity, etc. However, lack of mental awareness as to the real significance of such terms has blocked, in some instances, the translation of them into appropriate action. Such lack of mental awareness often is caused by unquestioned faith in and adherence to long established practices. This is particularly true in regard to existing plans, in certain strategic areas that have come under the observation of the writer, for the care of casualties resulting from air raids and other emergencies. These plans, which have remained essentially unchanged for many years, consist, for the most part, in the employment of first-aid lockers and fixed dressing stations.

The idea of first-aid lockers is sound if they are numerous, well distributed and easily accessible, to be used by nonmedical personnel in administering first aid. However, they are unsuitable for the purpose of serving as major dressing stations. It is impractical for every first-aid locker to contain sufficient medical equipment and supplies to care adequately for any number of casualties of even a moderate degree of severity. An even more important objection to the plan of having fixed dressing stations attended by trained medical personnel is that it immobilizes and limits the usefulness of a precious number of doctors and hospital corpsmen.

We cannot anticipate where the bombs will fall during an air raid. But we do know that wherever they do fall within the strategic area, a large number of casualties will result with a high percentage of the wounds of considerable severity. Modern war experience has shown that the degree of morbidity and percentage of mortality are, to a large extent, directly proportional to the time it takes for the wounded to receive adequate surgical care. It might be the ligation of a vessel, the dusting of a wound with a sulfa drug or its closure, a debridement, the application of a splint or a cast, the early, adequate care for a burn or for shock that will save a casualty from a stormy siege, permanent disabilities and perhaps from death. Medical facilities should be so organized as to furnish such adequate surgical care as rapidly as possible and with as little confusion as possible. And there is nothing that makes for confusion and lowering of morale more than the necessity of transporting wounded for treatment. Arrangements should be such that the greatest degree of surgical care possible be rendered on the spot where the casualties occur, so that any delay in transportation to a hospital will be free of any sense of urgency and attended by least risk to the wounded.

Thus any successful plan for medical aid during an air raid must be predicated upon bringing treatment to the wounded and not the wounded to the treatment. To administer effectively to casualties on this basis requires a rapid concentration of medical personnel, supplies, and equipment. Such personnel should be so organized that they can be despatched immediately to any stricken area and so equipped that they will be able to set up and function as a surgical unit with the least possible delay. To that end the organization and equipment for a "mobile surgical unit" as described below is recommended.

THE UNIT

The "mobile surgical unit" consists of a truck or a trailer equipped as indicated below and manned by at least two medical officers and six hospital corpsmen. It is estimated that there should be one mobile surgical unit for each 2,000 men in the strategic areas. Dur-

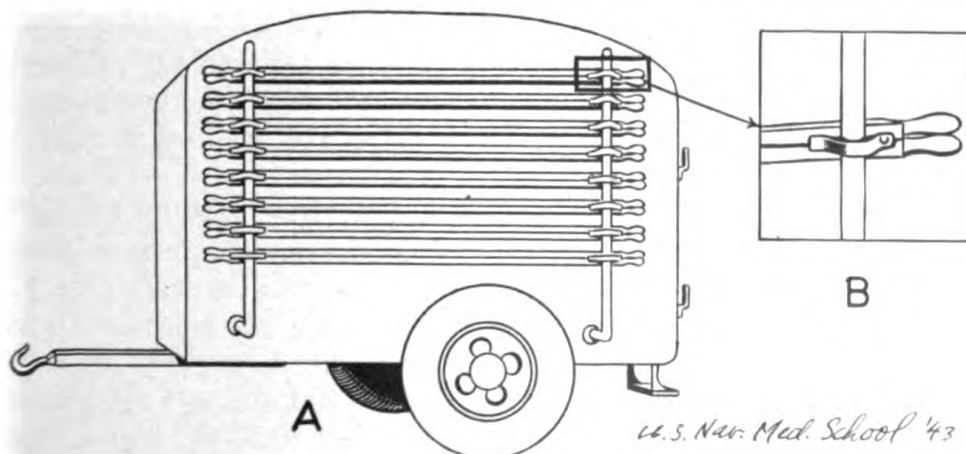
ing an air alert units should be held in readiness at the periphery of the strategic area and in communication with air raid control. Upon completion of a bombing phase, air raid control will direct the mobile surgical units to the various stricken areas. Upon arriving in a bombed area the medical officer in charge will take over the most appropriate building available and direct the setting up of the unit. Such setting-up will take from 3 to 5 minutes, depending upon the training and efficiency of personnel. It will be noted that all equipment and supplies of the unit are so stowed in the vehicle and in their respective containers, that their unloading and preparation for use can be accomplished expeditiously.

The mobile surgical unit consists of the following equipment and supplies:

- | | |
|--|--|
| 1 vehicle (any $\frac{3}{4}$ - or 1-ton paneled truck or trailer). | 1 stand, irrigator, adjustable, 2 hooks. |
| 16 litters, army type. | 6 hand lanterns (battery). |
| 1 water tank (100-gallon capacity). | 3 Thomas splints (leg). |
| 1 surgical case "A" (described below). | 2 Jones splints (arm). |
| 1 surgical case "B" (described below). | 1 oxygen-carbon-dioxide inhalation outfit. |
| 1 folding operating table. | 3 buckets. |
| 1 portable operating light (battery). | 24 blankets. |

Vehicle.—A three-fourths- or 1-ton paneled trailer is considered the most suitable from the standpoint of cost, availability, and utility. The advantage a trailer affords is that a motorized vehicle is not tied up awaiting the occasion for its use. The plan for air raid protection should include directives for designated motorized vehicles to haul their assigned mobile surgical unit trailer. A few minor additions to the trailer will be required as indicated.

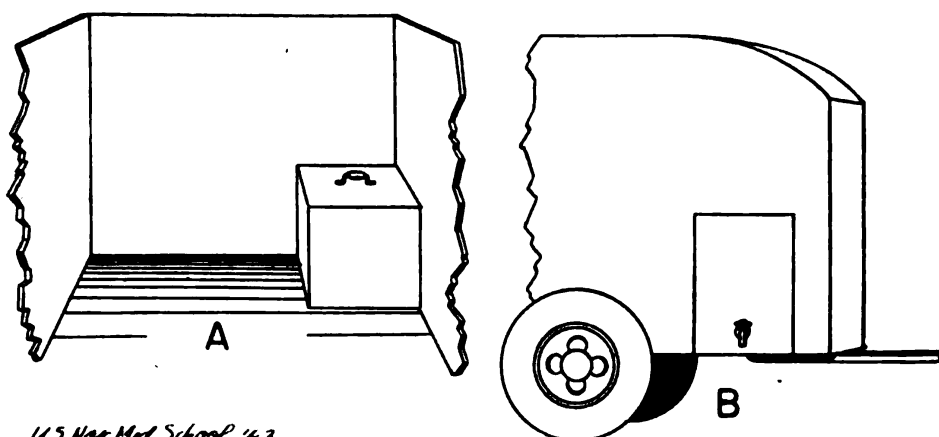
Litters.—Two pins are installed on the outside of each trailer panel to act as brackets for the army litters (fig. 1). In this manner, 8 litters can be carried on each side of the trailer, making a total of



1. (A) ILLUSTRATING HOW EIGHT ARMY-TYPE LITTERS CAN BE CARRIED ON EACH SIDE OF A TRAILER. (B) DETAIL OF METHOD OF STOWAGE.

16 litters available for use. The roof of the trailer can hold additional litters. The litters are to be used as cots wherever the unit is established. This will keep the wounded off cold and probably wet ground or flooring and permit eventual transportation with least disturbance to the victims.

Water tanks.—It is possible and, indeed, quite probable that bombing attacks will result in rupture of the water mains, thus interfering with water pressure and supply. To meet such a contingency, and any other reason for water being unavailable, the unit should carry its own water supply. For this purpose a water tank measuring $2\frac{1}{2}$ feet by 2 feet by $2\frac{1}{2}$ feet and having an approximate capacity of 94 gallons is installed just behind the front panel of the trailer. A spigot connecting with the tank is installed on the outer side of the trailer (fig. 2). Suitable hooks or brackets are installed on the inner side of



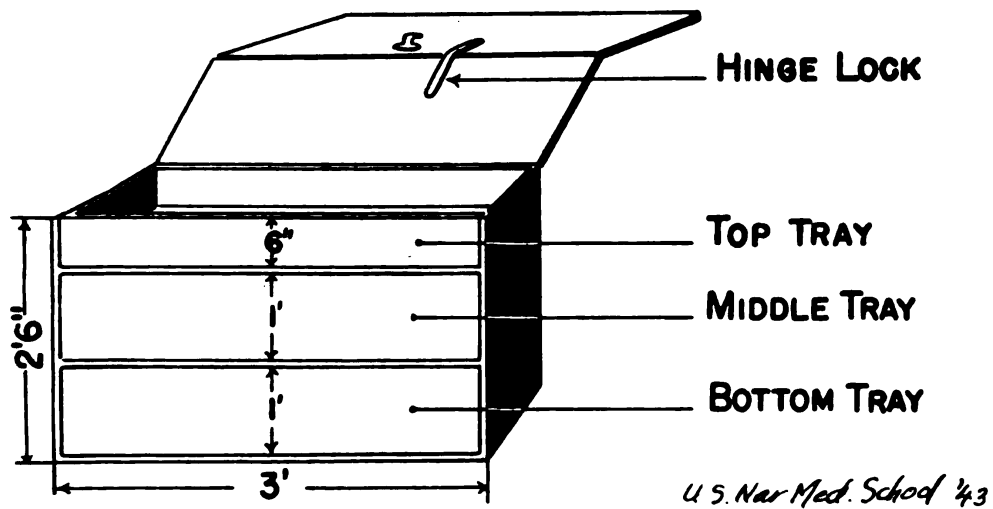
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2. (A) INSIDE VIEW OF WATER TANK SITUATED BEHIND FRONT PANEL. (B) SPIGOT READILY ACCESSIBLE ON OUTSIDE OF SIDE PANEL.

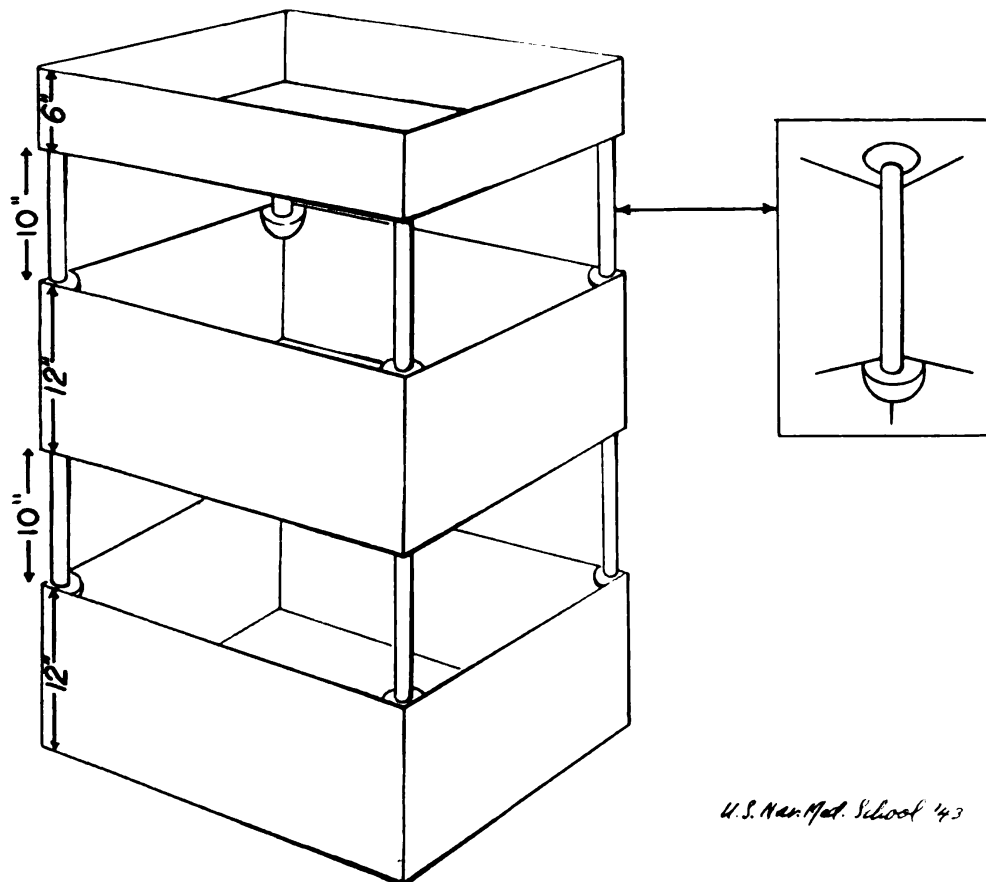
the trailer from which Thomas splints, Jones splints, hand lanterns, buckets, etc., are suspended.

The floor of the vehicle holds surgical cases "A" and "B", folding operating table case, portable operating light, oxygen-carbon-dioxide inhalation outfit, and blankets. The blankets are wrapped in canvas, four to a bundle.

Mobile surgical case "A".—This case measures 3 feet by 1 foot 7 inches by 2 feet 6 inches and holds three case trays. The front and top of the case can be lifted, permitting easy removal of the trays (fig. 3). Upon being removed from the case, the trays are mounted one above the other on eight dowel pins which are kept in the top tray (fig. 4). This keeps the case contents together and the supplies and equipment readily accessible. The top of the case is closed with the hinge locked and the front of the case is supported by two dowel pins which transforms the case into a table with a working surface measuring 38 inches

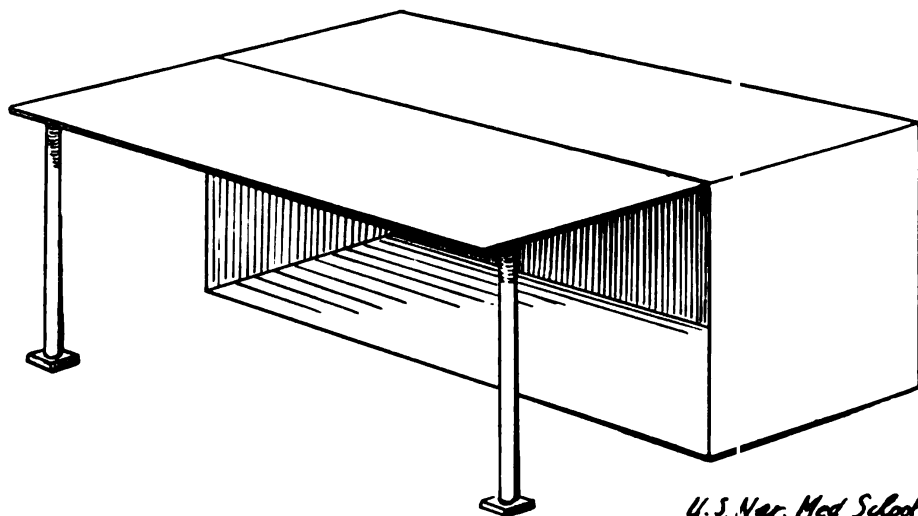


3. SURGICAL CASE "A".



4. TRAYS MOUNTED ON DOWEL PINS PERMITTING EASY ACCESS TO CONTENTS.

by 36 inches (fig. 5). On one half of the table are placed instruments and surgical dressings; on the other half, hand basins, sterilizing trays, pitchers, solutions, etc.



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5. CASE "A" CONVERTED INTO WORK TABLE BY MOUNTING FRONT LID ON DOWEL PINS.

Contents of the three trays of surgical case "A" are as follows:

TOP TRAY

- | | |
|---|--|
| 2 trays of instruments. | 3 field sheets. |
| 1 anesthesia tray for local and intravenous anesthesia. | 6 towels, skin. |
| 1 set of sterilizing trays. | 10 boxes of morphine Syrettes. |
| 4 operating gowns. | 1 medicine glass. |
| 6 pairs operating gloves, size 7½. | 1 bottle of epinephrine. |
| 6 pairs operating gloves, size 8. | 1 2-cc. hypodermic syringe with needles. |
| | 3 instant tourniquets. |

The instrument trays, measuring 14 inches by 11 inches, are double wrapped and contents are sterile. Each tray contains the following:

- | | |
|---------------------------------------|--|
| 2 Bard-Parker knife handle -4. | 6 prep. sponge sticks. |
| 1 Bard-Parker knife handle -3. | 2 large Parker retractors. |
| 4 Bard-Parker blades -20. | 2 small Parker retractors. |
| 2 Bard-Parker blades -10. | 2 small spatula retractors. |
| 8 Kelly hemostats, straight. | 2 large spatula retractors. |
| 8 Kelly hemostats, curved. | 2 rake retractors, dull and sharp (1 pair each). |
| 6 mosquito hemostats, straight. | 1 grooved director. |
| 6 Allis forceps. | 1 silver probe. |
| 2 Mayo dissecting scissors, straight. | 6 towel clips. |
| 2 Mayo dissecting scissors, curved. | 1 aneurysm needle. |
| 1 suture scissors. | 2 needle holders. |
| 2 thumb forceps, plain. | 1 assortment of suture needles, |
| 2 thumb forceps, rat toothed. | wrapped in gauze. |
| 1 long dressing forceps, plain. | |
| 1 rubber-jawed intestinal forceps. | |

- | | |
|--|-------------------------------------|
| 3 vials each of black silk O, plain 1, | 1 set 11-mm. clips. |
| and chromic 1 sutures, wrapped in | 1 1-oz. bottle of alcohol. |
| gauze. | 1 1-oz. bottle of 2 percent iodine. |
| 1 Michel clip inserters. | 2 medicine glasses. |
| 1 set 22-mm. clips. | 1 dozen 4- by 4-inch gauze wipes. |
| 1 set 16-mm. clips. | 1 dozen prep. sponges. |

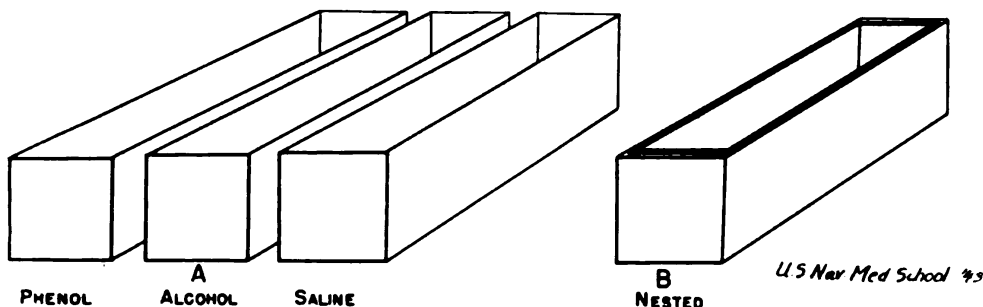
The anesthesia tray is likewise double wrapped and contents are sterile. The tray contains the following:

- | | |
|---------------------------------------|--|
| 1 set of contents of local anesthesia | 6 0.5-gm. ampules of pentothal sodium. |
| case, medical supply table number | 2 medicine glasses. |
| 2-535. | 3 packages gauze wipes 4 inches by 4 |
| 2 250-cc. bottles of 2 percent novo- | inches, 6 to a package. |
| caine. | 10 10-cc. vials distilled water. |

Sterilization of instruments is accomplished by immersion in phenol, then alcohol and finally washing in normal saline solution. For this purpose a set of trays are included of such dimensions that they can be nested (fig. 6).

MEASUREMENTS PERMITTING NESTING

- TRAY FOR PHENOL = $3\frac{1}{8} \times 3\frac{1}{8} \times 9\frac{1}{8}$
 TRAY FOR ALCOHOL = $3\frac{1}{8} \times 3\frac{1}{8} \times 9\frac{1}{8}$
 TRAY FOR SALINE = $4" \times 4" \times 10"$



6. TRAYS USED IN CHEMICAL STERILIZATION OF INSTRUMENTS. MEASUREMENTS PERMIT NESTING.

Middle tray of Surgical Case "A":

STERILE

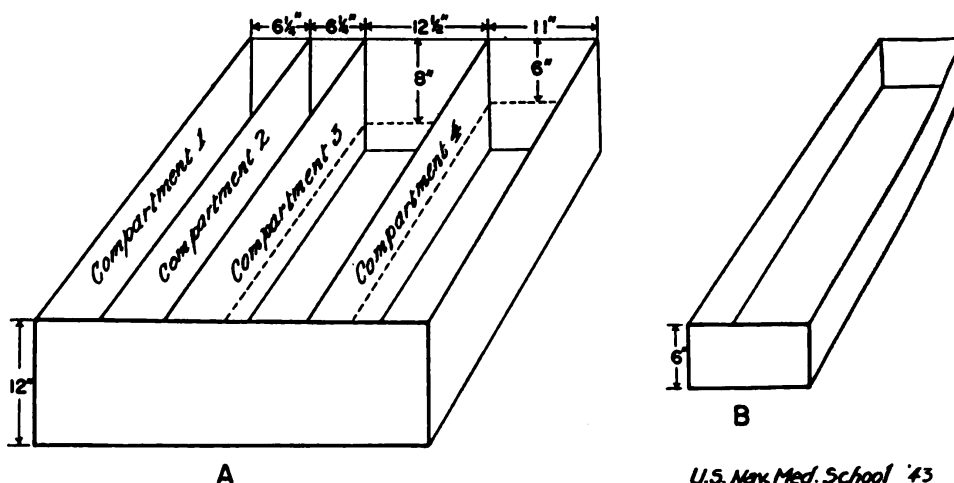
- | | |
|---|--|
| 24 packages gauze wipes 4 inches by 4 inches, 12 to a package. | 6 packages skin towels, 4 to a package. |
| 12 packages prep. sponges, 6 to a package. | 6 packages lap sheets, 1 to a package. |
| 6 packages tapes, small 3 inches by 15 inches, 4 to a package. | 6 packages operating gowns, 1 to a package. |
| 6 packages tapes, medium 4 inches by 14 inches, 3 to a package. | 6 packages operating gloves, size $7\frac{1}{2}$, 1 to a package. |
| 3 packages tapes, large 6 inches by 14 inches, 2 to a package. | 12 packages operating gloves, size 8, 1 to a package. |
| 12 packages compresses 10 inches by 10 inches, 1 to a package. | 4 packages tray covers, 3 to a package. |

UNSTERILE

- | | |
|-------------------------|-----------------------------|
| 2 rolls, roll gauze. | 2 pairs bandage scissors. |
| 1 roll, roll cotton. | 6 rubber tourniquets. |
| 1 roll, adhesive. | 3 webbed tourniquets. |
| 24 triangular bandages. | 2 dowel pins for front lid. |
| 2 cases pins, assorted. | |

BOTTOM TRAY OF CASE "A"

This tray is divided into 4 compartments, two of which have an upper and a lower section (fig. 7). Contents are as follows:



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7. (A) ILLUSTRATING COMPARTMENTATION OF BOTTOM TRAY OF CASE "A." (B) UPPER-SECTION TRAY FOR COMPARTMENTS 3 AND 4.

COMPARTMENT NO. 1

- | | |
|-----------------------|---------------------------------|
| 1 gallon jug phenol. | 1 gallon jug N-saline solution. |
| 1 gallon jug alcohol. | |

COMPARTMENT NO. 2

- 3 pitchers.

COMPARTMENT NO. 3

- | | |
|-------------------------------------|---|
| Lower section: | 2 250-cc. bottles triple dye. |
| 2 Hand basins. | 8 250-cc. bottles sterile N-saline. |
| 3 Pus basins. | 3 250-cc. bottles 95 percent ethyl alcohol. |
| Upper section (tray): | 2 250-cc. bottles 1 percent novocain. |
| 2 250-cc. bottles 2 percent iodine. | 2 bottles aromatic spirits of ammonia. |
| 2 250-cc. bottles Drene. | 2 bottles butyn. |
| 2 250-cc. bottles green soap. | |
| 3 250-cc. bottles boric acid. | |

COMPARTMENT NO. 4

- | | |
|-----------------------------------|--|
| Lower section: | 1 roll stockinet (3 inch). |
| 1 package basswood splints. | 1 piece felt, wool, 18 by 10 1/2 inches. |
| 12 cans plaster of paris bandage. | |

Upper section (tray):	3 bottles sulfanilamide powder.
2 stethoscopes.	200 tablets sulfanilamide.
1 sphygmomanometer.	100 tablets sulfathiazole.
4 medicine glasses.	12 packages sulfanilamide powder,
3 eye baths.	each package containing 15
4 medicine droppers.	gm.
2 clinical thermometers.	6 ampules pentothal sodium.
2 powder blowers.	6 ampules novocaine (100 mgm.).
3 hypodermic syringes, 2-cc., with	4 1-pound packages tannic-acid
needles.	powder.
½ package tongue depressors.	1 set of assorted sutures.
½ package applicators.	3 atomizers for spraying tannic-
2 jars sulfathiazole jelly.	acid solution.

Mobile surgical case "B".—This case measures 33 inches by 18 inches by 18 inches and has an upper and a lower section:

Lower section:	4 pairs rubber gloves, size 8.
6 vacolters (5 percent glucose in	6 packages gauze wipes, 4 by 4
saline).	inches, 6 to a package.
18 units of dried plasma.	6 skin towels.
	2 towel clips.
Upper section (tray):	The remaining space is filled
6 vacolter injection outfits ready	with an assortment of small, me-
for use.	diu, and large battle dressings.

Except for the portable operating light and oxygen-carbon-dioxide inhalation outfit, all equipment is on the regular or supplemental supply list. A very satisfactory light is the Castle emergency spotlight No. 30. This light is mounted in the battery box in the base. Batteries are self-charging.

A suitable inhalation outfit for resuscitation is the H-H Inhalator manufactured by the Mine Safety Appliances Co. of Pittsburgh, Pa.

The mobile surgical unit described above is recommended here primarily for use in strategic areas. Its further employment in civilian communities in the vicinity of those areas should likewise be considered.

TISSUE REACTIONS TO METALLIC IMPLANTS^{1 2}

OSCAR H. FULCHER
Commander (MC) U. S. N. R.
and

MERRITTE M. MAXWELL
Commander (DC) U. S. N.

This is presented as a brief contribution on the manner in which the dental surgeon may cooperate with the plastic surgeon in those cases requiring reconstructive surgery.

¹ Received for publication September 16, 1942.

² Read before the Washington Academy of Surgeons, April 10, 1942.

With the impression materials now available to the professions, accurate impressions may be taken of various anatomical defects and deformities, so that suitable models may be obtained for the construction of operative patterns. These patterns may then serve as invaluable guides in the proper trimming, shaping, and contouring of the reconstructive material, whether it be hard or soft tissue or metal plates.

Preliminary models will thus provide:

1. Preoperative study models for the planning of appropriate treatment.
2. Case records which give an accurate preoperative picture and postoperative result.
3. Moulds for the proper shaping of the selected reconstructive material.

There is considerable controversy and variation of opinion as to the most desirable metal or alloy to be used for operations of this type. Actual experimentation has given valuable data concerning the tissue reactions to various metals and their alloys.

The properties (1) which favor the use of tantalum are the following:

1. A strong, hard metal, highly resistant to corrosion and tarnish.
2. Inert in oral and body fluids.
3. Extremely malleable and ductile and can be readily worked to any shape.

Disadvantages in the use of tantalum are that it cannot be welded, soldered, or cast should it be desirable to obtain a more accurate pattern.

The cobalt-chromium series of metals have come into prominence for surgical use in recent years. Of these alloys vitallium and ticonium have been considerably discussed in the literature. Geib (2) gives three case reports in which vitallium was used. He states, "Vitallium is neutral in vivo and can be used for repairing defects of the skull. This metal makes the strongest and least complicated plastic repair of the skull known." Venable and Stuck (3) conclude that, "Pure metals alone are inert. * * * That it is electrolytic action which causes the formation of irritating metallic salts in the local fluids. The reaction against it leads to the excessive proliferation of cellular and fibrous tissue which is protective, and the inhibition of the growth of bone which is destructive." In their experiments with vitallium, they assert that the constituents of this alloy seem to have lost their potential, as there was no trace of chromium liberated in any instance. With reference to ticonium, Strock (4) states, "* * * this material, which was developed originally for dental prosthesis, has already been satisfactorily applied in surgery and is a material which should be extremely useful, if not invaluable, in traumatic war surgery."

Bothe and Davenport (5) state that too much emphasis has been placed on electrical effects of metallic implants and that too little attention has been given to the more general properties of the solubility of metals in body fluids and the reaction of tissues to the dissolution products. Data collected as the result of their metallic implants in animals would indicate that:

Electrolysis is not the primary cause of unfavorable bone reactions. The primary causes are determined by physical and chemical properties of the metal itself. Solubility and the degree of toxicity of the dissolution products appear to be the chief factors in producing tissue reactions. Alloys which consist of nontoxic metals should be nontoxic regardless of potential differences of their components. Theoretically, vitallium comes nearer to meeting this requirement than stainless steel but tantalum may prove to be the metal of choice when sufficient data on it have been accumulated.

Burke (6) reports eleven cases in which tantalum wire has been used for subcutaneous suture; in one case a fractured patella and a fractured medial condyle of the humerus were wired; and two plates have been used in the internal fixation of fractures. He reports further that tantalum implants were secured to the leg bones of six dogs and rabbits and removed at periods ranging from three weeks to three months. In each case the tantalum screws were held so tightly by the bone that considerable effort was necessary to unscrew them. He states, "There was no macroscopic, microscopic or x-ray evidence of bone or soft tissue irritation. The normal progress of healing was the only reaction detected."

A review of the data available at this time would seem to indicate that tantalum is the metal of choice in those cases requiring metallic implants.

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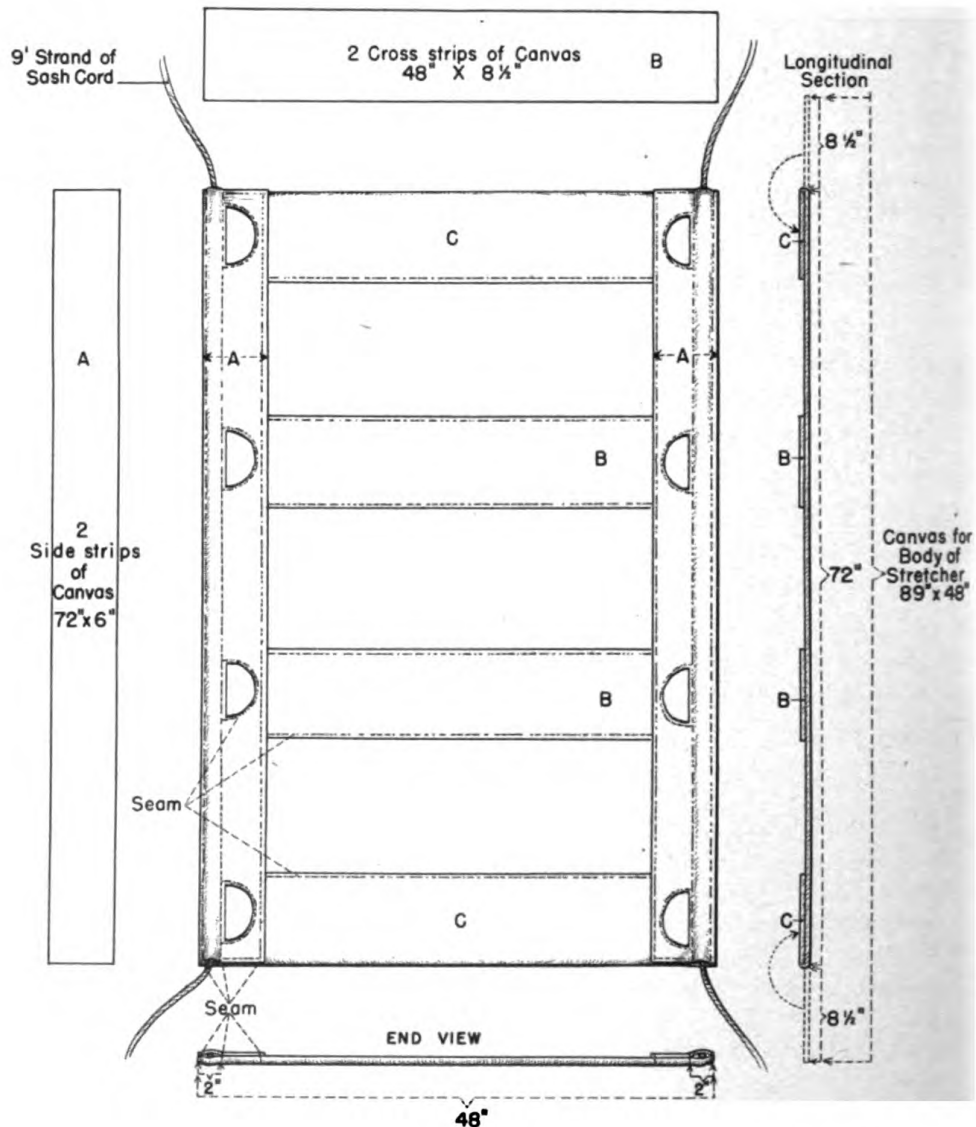
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A NEW EMERGENCY BED LITTER ¹

WARREN S. DOROUGH

Lieutenant Commander (MC) U. S. N. R.

There have been many devices designed for the transportation of patients and each has been designed to meet some particular demand or condition. The canvas bed litter here described was designed to



CONSTRUCTION DIAGRAM

U.S. Navy Med. Dept. 1942

meet a particular need. In wooden, frame hospital wards the time element involved in evacuating bed patients in emergencies may well play a large part in the number of lives saved. This device, worked

¹ Received for publication December 14, 1942.

out in collaboration with other members of the surgical staff, seems to meet this demand.

The canvas bed litter is placed upon the mattress (under the sheet) of all strictly bed patients and remains in this position until the patient is ambulatory. Accompanying illustration is self-explanatory. In the event of an emergency, the handholds are grasped and the patient is moved off over the foot of the bed without the loss of time occasioned in moving beds, lockers, etc., in transferring helpless patients from their beds onto regular litters. It is felt that this litter meets a definite demand. It is easily conceivable that its use will meet other conditions, as aboard ship or in any crowded space where the time element must be met in removing patients. It is readily stored, folded, and is simple in construction. If found desirable to employ the device as a "two-man" stretcher or as a rigid frame litter, either wood or metal poles may be inserted through the handhold openings.

SUGGESTIONS FOR MASS LABORATORY EXAMINATION OF RECRUITS ¹

CLYDE B. CAMERER

Captain (MC) U. S. N.

and

ARTHUR A. HUMPHREY

Lieutenant Commander (MC) U. S. N. R.

The methods of performing laboratory examinations on large numbers of incoming recruits differ in many details at various stations although the routine is probably basically the same. It is the present intent to stress innovations in the routine procedure which tend to expedite and render more efficient this phase of the medical examination in reception centers.

The routine laboratory examinations on the incoming recruit ordinarily consist of a Kahn test, blood grouping, and urinalysis. These procedures have been streamlined to eliminate unnecessary steps and thus enable us to take the specimens for the foregoing tests from a platoon, or group of 64 to 70 men, in 10 minutes, employing a team of 5 corpsmen.

An alphabetically arranged roster of the group to be examined arrives with the leader and he assists in numbering them on the list in numerical order by having them count off in muster. The odd numbers then form one line in order and the even numbers another. The platoon or company then streams in two lines through

¹ Received for publication December 17, 1942.

the laboratory or room set aside for the purpose, by the stations set up for withdrawing blood. At each station one corpsman draws the blood and places the 5 to 7 cc. sample in a test tube in a rack placed on a table between the stations, the hole in the rack bearing the same number as the recruit. The corpsman then hands the syringe and needle to the other member of the team who in turn replaces it with a clean syringe and needle. The corpsman supplying syringes can manage with as few as three at one time, as he cleans them by washing in a vessel of running water under a convenient tap, followed by a rapid rinse in sterile saline to prevent hemolysis. A needle is then placed on the syringe, being removed by forceps from a sterile container. It can be seen that for all practical purposes the only sterile object need be the needle.

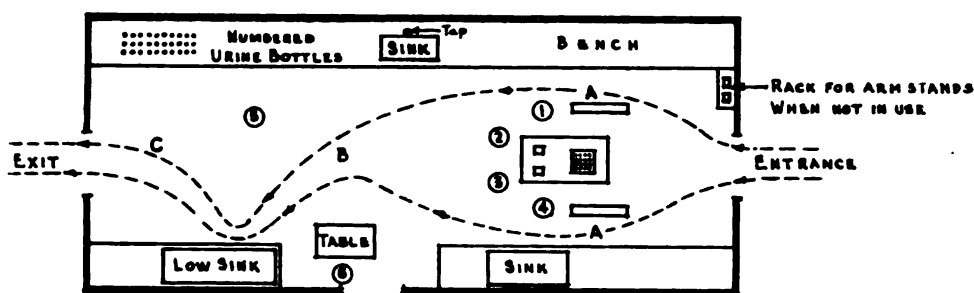
It was realized at an early date that if it were necessary for the recruit to be seated while the blood was drawn, considerable time would be lost, and likewise, if he extended his outstretched arm while standing, great difficulty would be experienced in drawing the specimen. Consequently, an arm rest on a pedestal was devised. This was used for a time with great success. This rest has been altered so that at present it consists of a board some 22 inches long secured at an angle of 35° to a 4 by 4 inch upright which fits in a square slot in the floor. This arm rest is 39 inches above the floor level at the lower end and the recruit extends his arm downward on its surface, giving the member considerable stability and also allowing quick application of a tourniquet, the midportion of which is fastened or stapled to the face of the board in such a position that it can be brought forward just above the elbow and secured with one motion about the arm. Many recruits, of course, do not require the application of a tourniquet to facilitate the withdrawal. While in others they can be instructed, while in line, to twist their uprolled sleeve to serve the same purpose or use the other hand. Variations in height of the examinees make but little difference with the device as the shorter need but to stand beside rather than are filled with shorter pieces of 4 by 4 inches, whose tops are flush behind the arm rest. When not in use the stands are stowed in an out-of-the-way place in a two-holed rack, and the holes in the floor with the deck and fitted with ordinary hardware fingerholes for easy removal. Placing the standards in slots eliminates the bulky and unstable bases and permits the room to have a clear deck when they are not in use, thus releasing the space for other laboratory procedures.

Pint milk bottles, with adhesive tape numbers, are used for the collection of urine specimens. These are maintained in proper order by the corpsman detailed to this duty. A long, low sink at one end of the room for this collection obviates soiling the deck, or an

inconvenient trip to the head. An unsuccessful attempt was made to employ large test tubes for this purpose, a method still employed at some stations.

Because of the volume of work and the lack of sediment in many of the specimens, a microscopic study is not warranted on the urines. Likewise because they are not morning specimens, and the water intake and the character of the diet are unknown, the value of performing tests to determine the reaction and specific gravity is of dubious importance. These were formerly done on all recruits passing through this station, but we now feel that anything further than the chemical tests for sugar and albumin constitute a waste of time and material.

Kahn tests are performed in the usual single tube manner, but if a suspicious one is encountered a three tube set-up is made on the same serum, and a repeat is requested within 3 days.



Floor plan of laboratory room devised for collection of specimens (somewhat diagrammatic).

The dotted lines show the two streams of men progressing through the laboratory from right to left. The recruits stop at "A" and while standing with arm on the rest, blood is drawn by corpsmen (1) or (4), who are furnished fresh syringes by their respective teammates (2) and (3). The blood is then placed in the proper tube in the numbered rack on the table between them. This table also bears rests for other fresh syringes and a container filled with sterile needles.

The recruits are handed numbered urine bottles at "B" by corpsman (5) who collects them filled at "C" after the examinee has voided over the sink at the lower left; he also checks with the group leader (6) who is seated at a table with the numbered roster. (5) and (6) see that the men keep in order so that errors in the identity of specimens will not occur. The sinks for washing syringes are ranged on both sides of the room; it is practical to place a vessel under the running tap.

Blood grouping has been simplified by using large glass plates covered with an orderly arrangement of numbered, raised rings, some 40 or more to the plate. These rings are placed in pairs and produced by dipping a five-eighth-inch test tube in thick black paint and applying it to the glass over a prepared plan drawn on white paper under the plate. This is a variation of the wax rings used in various serological tests but the paint withstands washing without being baked on and the ridge is sufficiently high to retain the sera and cell mixtures. Typing sera of the two diagnostic groups are placed in the logical tests but the paint withstands washing without being baked

tubes are carried to the drops of serum by dipping applicator sticks in the blood, or clot, and mixing it in the proper proportion with the serum. Further mixing is done by tilting and rotating the entire glass sheet. Use of this method eliminates expensive hollow-ground slides, greatly facilitates washing, and large numbers of groupings can be mixed by rotating the large sheet. An adequate supply of pooled typing serum is constantly at hand, as it is continually replenished from the excess serum on the withdrawn blood samples.

SUMMARY

An outline of laboratory procedures for the examination of new recruits at reception centers has been presented. While some of the methods described are in general use, it is felt that the adoption of some of the variations in technic may result in increased efficiency and speed in handling large numbers of men.

A FRACTURE DEVICE FOR THE NOSE¹

DAVID R. WOMACK

Commander (MC) U. S. N. R.

As in the case of any other bone, the successful treatment of fractures of the nose requires good approximation of the fragments. This is very difficult to obtain in nasal fractures due to the difficulty in maintaining the parts in position. In the past, fracture devices have been limited to internal and external splints which are not entirely satisfactory. The present device is considered to be an improvement over the other methods now available and to be a step in the direction of eventually obtaining a more perfect appliance for maintaining the correct approximation of the fragments of the bones of the nose. It has been in use for 2 years with the incorporation of a number of changes, and seems to be fairly well worked out at the present time.

The old internal splints are easily applied but due to the secretion of the mucous glands they slide out; and also pressure is unevenly exerted and impossible to evaluate or control. It is also difficult or impossible to maintain the proper position of the fragments.

External appliances were fairly satisfactory with a wire (bent coat hanger) incorporated in a fronto-occipital plaster bandage; however here again it was difficult to obtain the proper adjustments and impossible to bend the wire to obtain just the right amount of tension desired. The old external splints using a roller bandage never held at all. Acrylic splints made in the dental laboratory

¹ Received for publication Sept. 30, 1942.

and molded for each individual face did not answer the purpose because they could never be securely fastened and the proper amount of traction or pressure could not be obtained. They usually depended on adhesive plaster fixation, which is not satisfactory.

The present device was developed somewhat from the idea of the old coat hanger, keeping in mind the adjustments desired and the forces required to maintain a satisfactory approximation of the bony fragments. It is designed primarily to maintain bony frag-

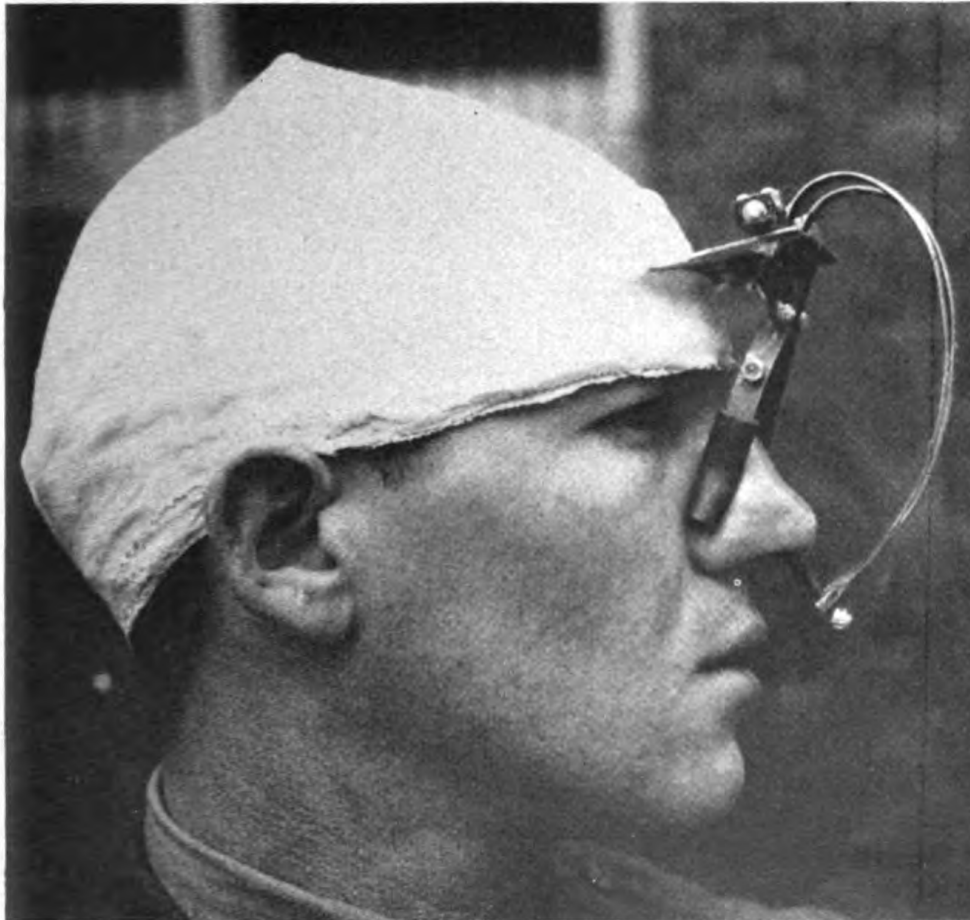


FIGURE 1.

ments in their proper position after they have been "set." As a matter of fact, it has been found that in nearly all cases the splint can be applied without any previous manipulation and the nose can be set and the fragments adjusted very simply and quickly by making adjustments on the device.

A major problem in the fractured nose is the telescoping of the narrow bridge of the nose into the broader basal fragment due to the slanting of the nasal bones. Another factor is the maintenance of the septum in a straight position after it has been shattered more or less

in different places. When fractured there is a tendency for the bone to override and buckle on itself. At the same time the nasal bone is drawn down and the distal fragment may telescope into the proximal fragment. Keeping these forces in mind, it is seen that some elevation of the bridge of the nose and to maintain this elevation a force is needed. At the same time a force must be exerted to straighten the septum. In addition there is often some lateral displacement of the nose which must be corrected.



FIGURE 2.

To maintain traction or pressure inside the nose some fixation must necessarily be utilized. This is accomplished by the use of a device at the end of the adjustable arms of the device. The end of each arm is covered with a small acrylic tip made by the dental department or a stainless steel tip made by the instrument maker. The acrylic cap carries the major portion of the stress and strain and must be positioned properly and accurately to obtain good results. To accomplish this three adjustments are included in the device.

an in-and-out adjustment screw on the adjustable arm which would position the cap at the proper place up and down in the nose. Next an adjustment is provided by the screw under the flange or horizontal plate to give the adjustment fore-and-aft necessary to obtain the right amount of lifting power. Lastly to care for lateral deviation the carriage for the long adjustable arms is a lateral screw placed on the flange or horizontal plate which will permit wide adjustments of the acrylic cap from one side to the other. The large adjustable arms are symmetrical so that an adjustment point may be maintained in either or both nostrils at the same time. Some fractures require the utilization of only one of the arms while others are best treated by utilizing both arms.



FIGURE 3.

To obtain still more perfect adjustment and to correct for lateral deviation, the two small broad arms made of spring steel coming off under the horizontal plate and extending on each side of the external nose are utilized. Any desired amount of tension can be exerted on these arms by adjusting the small screw on the side. This portion of the device is entirely removable for two reasons: First, some cases do not need any external pressure and the omission of this part simplifies the appearance of the device; second, it is easier to apply the plaster roller with this part of the device left off. It is secured by one dowel pin and one screw to the horizontal plate and may be easily applied or removed by means of this screw.

This is the basic instrument. It is applied by first making a stockinet skull cap which is applied over the head without using

cotton batting. Two plaster bandages $2\frac{1}{2}$ or 3 inches wide are used. A simple occipitofrontal roller is applied, care being taken to include the external occipital protuberance. After two or three turns the instrument is properly positioned with the curved vertical plate resting against the plaster over the forehead in such position as the operator deems best for the particular fracture in question. While an assistant holds the fracture device against the head, additional turns of the plaster bandage are placed over and under the horizontal plate until the entire device is secure. Time is then permitted for the plaster to harden and then the acrylic caps are positioned as desired in one or both nostrils. These caps of course should be inserted high enough to come under the nasal bones and exert the proper traction thereon. If there is any large amount of deformity this may be corrected with slow, accurate adjustments, after proper anesthesia of the nose. The positioning is then completed by adjusting the three screws referred to above, until the proper position is obtained. The lateral external strips are then adjusted to the bridge of the nose externally if desired, or they may not be used at all. These external strips are covered with soft rubber tubing to prevent damage to the nose. Too great pressure is not to be exerted since it may cause necrosis. However, adequate pressure for alinement purposes can be maintained without danger of necrosis.

The anesthetic used is the standard A-C mixture which basically is 1 percent cocaine applied on cotton tampons inserted in each nostril and left for a period of 15 or 20 minutes.

The reduction with the device is much less painful than with the manipulation and application of internal tampons, and it is much more comfortable than external splints with roller bandages and adhesive tape. Likewise the position is maintained, which is not the case with the use of the external splints on the market today.

The instrument is quite easily worn and although it looks awkward it does not interfere with eating or vision. Patients rarely complain of wearing it and have uniformly been very grateful for the results obtained.

The device can be made very easily in any A & R or similar shop. Blueprints are available, on request, covering the complete manufacture of the device.

EDITORIALS

SOME RECENT ADVANCES IN THERAPEUTICS

Imminence of infection incident to war makes mandatory the exploitation of every available antiseptic. Intense interest in the sulfonamides has overshadowed a group of chemical agents entirely new and unrelated. Fraught with promise and therapeutic possibilities, their human application awaits only the clinical astuteness of a Colebrook or a Marshall.

Some are antibacterial whose source is the living cell. Others are chemicals well known whose combinations have yielded an intensification of the effects of the components.

Considerable credit is due to Hotchkiss and Dubois for their pioneering work with tyrothricin, tyrocidin, and gramicidin, as likewise to Fleming for his studies with penicillin.

Tyrothricin obtained from a culture of aerobic sporulating bacilli found in the soil is strongly bactericidal for many gram-positive and gram-negative organisms in vitro. It is not a pure substance, however, and its clinical employment awaits a broader investigation. Tyrocidin and gramicidin are crystalline fractions of tyrothricin and as essentially different in their biological characteristics as in their chemical composition. Tyrocidin is an antibacterial and behaves like antiseptics of the metal and chlorine group. It is a general protoplasmic poison and destroys the metabolic activity of the cell. It has definite protective action, in mice at least, against a pneumococcal infection.

Gramicidin on the contrary does not act like a general protoplasmic poison and does not interfere with the cell morphology. It is essentially a bacteriostatic agent particularly for gram-positive organisms. Highly effective against pneumococci, streptococci, staphylococci, and diphtheria bacilli, it is ineffectual on gram-negative bacilli.

Gramicidin's usefulness in human infections has been limited to local application where its therapeutics is of considerable expectancy, especially now in the light of extensive war injuries.

Penicillin, a substance elaborated in culture by a mold resembling *Penicillium rubrum*, is also a complex antibacterial agent. Some of the fractions appear to be immensely more potent than the parent

substance. Under similar conditions its antibacterial action has been found to be as much as 300 times as potent as sulfapyridine and sulfathiazole (Gold). A bacterio-inhibitory substance, it affects most markedly pyogenic cocci and bacilli of the diphtheria group. Staphylococci are particularly sensitive and the inhibitory effect is practically the same on all strains.

Streptococcus pyogenes, pneumococci, *B. diphtheria*, gonococci, meningococci, and some gram-negative cocci found in nasal catarrh are equally susceptible.

Recent studies have intimated that in very low concentrations penicillin as well as gramicidin has a complete bactericidal property after several hours application in vitro.

We are encouraged by the extensive investigation being done on these substances. To the uninitiate it has appeared that medicine had reached its ultimate, that therapy had been reduced suddenly to the single "cure-all" epitomized in the sonorous euphonym—sulfonamide.

However, exhilarating indeed it is to read that even some of the more simple chemicals, as potassium permanganate and boric acid, are found to possess unqualified effectiveness, especially in many crushed, contaminated, and infected traffic and war wounds.

Györfy states that the potassium permanganate mixture of von Mezö represents an intensification of the effect of either substance singly, and that 6 hours after the application of this harmless powder mixture there results complete bactericidal action.

Every efficient remedy is worthy an honest trial. We progress when thought is seasoned with latitude and our way of thinking is not grooved into singleness.

THE PERENNIAL PNEUMONIA PROBLEM

In the *Pennsylvania Medical Journal* for January 1943, under the title "All That Is Called Pneumonia Is Not Pneumonia," appeared a critical analysis of 377 deaths ascribed to pneumonia occurring in hospitals in central Pennsylvania. The committee reviewing the records concluded that in 130 of these cases death definitely was not due to pneumonia, and in 31 more cases death probably was not due to pneumonia.

Admitted are the inaccuracies inherent in such a study drawn entirely from records. Nevertheless such a study brings out two appalling conclusions: First, the necessity of good record keeping, and second, accuracy in diagnosis. To make pneumonia the "diagnostic wastebasket," the subterfuge for "not knowing," is regrettable. Such procedure is not consistent with good medical practice. Ob-

viously pneumonia is being diagnosed as a cause of death more frequently than the facts justify.

Faced with the explanation of the cause of death and the legal requirement of stating that cause, the physician is apt to make a diagnosis of pneumonia simply on the presence of a few râles and an increase in temperature. Often cardiac heart failure will describe more accurately this situation.

Conversely the increased incidence of virus or atypical pneumonia pervading the literature places an added responsibility upon the diagnostician for a more exhaustive and energetic search into the probable cause.

However accepted the terms may be, the condition demands a more positive conclusion before cataloging it a pneumonia or a pneumonitis, or a veiling of dubiety under intriguing titles as new or atypical. A trifle ritualistic perhaps, but it is a plea at least for honesty in diagnosis.

PILONIDAL CYSTS

The prevalence in current literature of articles on pilonidal cyst reflects the occurrence of this disease in inductees for the armed forces. To do something about it is the natural expression of a healthy medical corps. The rehabilitation and return of personnel to military duty as quickly as possible is tantamount to the *raison d'être* of the corps.

When dealing with sinuses of this type, however, several important factors should be considered. The primordial character of the cells potentiates at least an inherent power of growth. Without complete excision the congenital nature might exert itself in regeneration of a retention pocket with recurrence.

Definitively, if not actively, the lesion is an infected one and demands surgical principles commensurate to time-tried experience in handling such lesions.

The arborization structure of the sinus is more frequent than the restricted simple midline dendron and as such will tax the ingenuity of the surgeon's skill to dissect out every branch in its entirety.

Closure of such a void by primary intention attempts a circumvention of the surgical axiom regarding closure of infected wounds. The very nature of the location of the lesion makes difficult the exclusion of dead space, the collection of serum, or the pocketing of fat oil—prerequisites essential to successful primary healing.

However, complete excision with primary closure at least theoretically has a tang of probability. Many have tried this method and the increased number of articles in the literature seem to indicate

frequent successful attempts in this direction. The reduced number of recurrences appears decidedly to portend the feasibility of the method.

Assuredly in its favor is the decreased time of convalescence. But nature is an inexorable wench and refuses at times to tolerate infractions of so-called inviolable principles with impunity.

Commendable it is to attempt short cuts, only be not discouraged if the remote future reveals the futility of such a plan.

HARVEST

In 12 days, from January 5th to 16th, Death's scythe garnered Sir W. Arbuthnot Lane, Howard A. Kelly, George Crile, and George Washington Carver. One died a baronet; one was born in negro poverty in a Missouri cabin. But it is not in those terms that we can measure the comparative value of their contributions to science.

Lane's preeminence was due to an agile, provocative, restless mind as well as to his actual surgical achievements. At Guy's he first brought into practice the strict principles of aseptic surgery. His uncanny dexterity made his reputation while still a young man. His first publication was in 1883. In 1893 he was using screws in the treatment of fractures. His "Lane's kink" was in the title of a paper by him in 1910. His colonic surgery was possibly misguidedly enthusiastic. He was made a baronet in 1913. He died at the age of 86.

Howard Kelly was a year and a half younger than Lane. He worked on a mountaintop as high as Lane's. Gynecology, local anesthesia, fostering of medical illustration, and in his later years radiology, all bear indelible imprints of his activity. His honors were innumerable: his literary contributions profuse. Like Osler, like Halsted, like Welch, it was not only packed mind and dexterous technic that drew devoted students, but broad interests, great enthusiasms, and audience appeal made it a delight to be in his presence.

George Crile completes the triumvirate which surgery claims out of this foursome. Though only 6 years younger than Kelly, he seems more nearly of the present day. Sir Arbuthnot and Howard Kelly had moved into the quietude of earned rest, while Crile continued his activities to the end. At his death he was consultant to the Medical Department of the United States Navy.

Crile's doings are too recent to need any description. Preeminent in surgery, perfecter of technic, pioneer in endocrine work and in cancer and gall-bladder research, organizing member of the American College of Surgeons, etc., plus his many contributions to surgical literature, give but a sketchy idea of his many facets. His grace and

charm of manner and presence, his capacity for making friends, his infectious enthusiasm, made it a delight to listen to him either from the lecture platform or across a dinner table.

And now the fourth, what the world would call the "lowliest" member of this constellation, George Washington Carver. Always the full resonance of the three names; never George Carver, never George W. Carver, and the three words evoke the picture of a venerable, humble member of a darker race. His achievements were not in medicine but in allied lines of science, yet no one of the three surgeons would have failed to pay full homage to that negro mind.

Measured in terms of commercial value to his Nation (not only to his race), Carver tops the four. The others can be measured more properly in terms of value to humanity.

George Washington Crile and George Washington Carver were both born in 1864. Carver died in the harness he built for himself, laboring to the last for the improvement of commercial methods in the South and, through broadened prosperity, an improvement in the living conditions of his race.

It is inconceivable that the coincidence of four such toppling deaths in such a pinpoint of time can have occurred or ever will occur again. Moreover, it is a challenge to name four men in science now living who can match these. There must be feastings in Valhalla!



CAUSES FOR SULFONAMIDE FAILURE

The following should be thought of as possible causes for the unsuccessful sulfonamide therapy of pneumonia.

- (1) Pneumonia not due to sulfonamide-affected organisms.
 - (2) Improper selection of drug.
 - (3) Chemotherapy too late.
 - (4) Chemotherapy too little.
 - (5) Drug toxicity.
 - (6) Antisulfonamide substances present.
 - (7) Failure to employ other established therapeutic measures.
- Flippin, H. F.: Causes for unsuccessful sulfonamide therapy of pneumonia. *South. M. J.* 36: 223, March 1943.

ANORECTAL TUBERCULOSIS

Most authorities now agree that about 5 percent of consumptives contract anorectal tuberculosis, that is, tuberculous abscess or fistula. It is also agreed that most of these lesions begin as simple, that is, non-tuberculous conditions, which become only secondarily invaded and infected by viable tubercle bacilli. Kantor, J. L.: Digestive disorders in the tuberculous and their management. Rocky Mountain Med. Jour. 40: 171, March 1943.



TEETH OF THE SELECTEES

Dental caries is of importance as a health problem of both children and adults, but control of the disease must be undertaken during childhood. Selective Service figures show that 188,000 young Americans, examined during 1941, did not have 12 strategically placed teeth. Most of these men had lost 20 or more teeth and dental disease was the most important single cause for rejection.—Robinson, H. B. G.: Dental caries and the metabolism of calcium. J. Am. Dent. A. 30: 357, March 1, 1943.



THEORY OF SULFONAMIDE ACTION

Thus it appears that the sulfonamides possess a bacteriostatic effect which does not directly destroy the bacterial cells, but which leads indirectly to the destruction of the organism by virtue of their antagonistic action through interference with bacterial proliferation. Hence, the effectiveness of the sulfonamides against bacteria depends to a large extent on the ratio of the number of molecules of sulfonamides on the one hand and the bacterial supply of nutrient substance on the other. Flippin, H. F.: Causes for unsuccessful sulfonamide therapy of pneumonia. South. M. J. 36: 220, March 1943.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

DISEASES AND INJURIES OF THE LARYNX, A Textbook for Students and Practitioners, by *Chevalier Jackson, M. D., Sc. D., LL. D., F. A. C. S., Honorary Professor of Broncho-Esophagology, Temple University, Philadelphia*; and *Chevalier L. Jackson, A. B., M. D., M. Sc. (Med.), F. A. C. S., Professor of Broncho-Esophagology, Temple University, Philadelphia*. 633 pages with over 200 illustrations. The Macmillan Co., New York, publishers, 1942. Price \$8.

"Diseases and Injuries of the Larynx" is the modest title which the Jacksons, father and son, have chosen for this, their eminently readable contribution. It is a refreshing method of study. Its authoritative simplicity inspires in the reader a friendly and assuring understanding of the many problems that must be faced by the human larynx.

This book, more by virtue of the chapter "War Surgery of the Larynx," is really a corollary of the original 1937 edition yet completely avoids a repetitious style. The intention of the authors was fully realized. It will prove to be not only a bulwark of comforting security to the "specialist" but also to the general practitioner and student a dependable guide and textbook.

Possibly of all areas the larynx is the most misrepresented and abused, due largely to our smug and chronic ignorance. The increasing tendency in this war toward hand-to-hand fighting has exposed this vulnerable area to unusual assault. The laryngeal emergency presents a situation that must be challenged instantly. Immediate action being the order, this book's simple directness stimulates greater courage and conviction in the hesitant operator.

The authors cannily guide the reader through the various grades of the laryngeal problem. Nothing is too sublime, nothing too lowly

to escape consideration. From the primary anatomical and physiological review, up through the grades of anomalies and malformations, on to an adroit discussion of the acute and chronic inflammations, a consideration of the effects of tuberculosis and syphilis, a study of benign and malignant tumors, and surgical procedures in exact detail, the volume is climaxed with the timely chapter "War Surgery of the Larynx." A complete knowledge of this book is not always possible, but a working knowledge of its contents, with the book always available for reference, will avoid many anxious moments.

Books of this type defy classification. The general understanding of the larynx is so scant that the stage has not been reached when comparisons are possible. All books on the larynx by our recognized men are ipso facto of such inestimable value that the question of replacing one book by another is pure folly. It would be far more to our advantage to consider this volume as a new and younger member of "the family."

A TEXTBOOK OF FRACTURES AND DISLOCATIONS, Covering Their Pathology, Diagnosis, and Treatment, by *Kellogg Speed, S. B., M. D., F. A. C. S., Professor of Surgery (Rush) of the University of Illinois*. Fourth edition, thoroughly revised. 1,106 pages; illustrated with 1,140 engravings. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$12.50.

The author, in his preface, keys the sane and rational handling of fractures and dislocations which he advocates in the text. He states: "Fractures seldom are so urgent as to justify overhastened treatment—study the patient and the fracture and—proceed so intelligently that a full plan of treatment is visualized from the beginning."

Detailed description of the underlying anatomy is given as the basis for the consideration of treatment of each specific fracture and dislocation. Symptoms, remote and immediate, and a discussion of the eventual disability add to the well-rounded description of the specific injuries. The technics of reduction, immobilization, operation, and after-treatment advocated are those which have proven successful. The bizarre methods, so common in practice and occasionally successful in the hands of their originators, are eliminated from consideration. To each chapter is appended a well chosen bibliography.

The illustrations are numerous, well selected, clear, and informative. The printing is clean and on good stock. The binding is serviceable.

In all, it is a most excellent and practical treatise of distinct value to practitioner and student.

FIRST AID, Surgical and Medical, by *Warren H. Cole, M. D., F. A. C. S., Professor and Head of the Department of Surgery, University of Illinois College of Medicine; Charles B. Puestow, B. S., M. S., M. D., Ph. D., F. A. C. S., Associate Professor of Surgery, University of Illinois College of Medicine and Graduate School; and 17 other medical authorities.* 374 pages with 186 illustrations. D. Appleton-Century Co., Inc., New York, publishers, 1942. Price \$3.

In their foreword the authors make a plea for the teaching of the principles of first aid not only to the medical students, but also to all pupils at some lower level in the educational system. Such an ideal will receive the support of thoughtful physicians who view knowledge of this subject, like that of elementary anatomy and physiology, as proper equipment for living. The volume under consideration is intended to be useful to those without actual medical knowledge, to Red Cross workers, medical students, and physicians. That so heterogeneous a group can successfully adopt any one book as a text on this (or any other) subject is doubtful.

This volume is not a simple manual of first aid by design, for it presents anatomical, physiological, and biochemical considerations of certain injuries and medical emergencies at some length. The lack of a single viewpoint among the authors of the various chapters as to the group to be addressed is reflected, therefore, in considerable variation in the treatment of their respective subjects. The chapter by Percival Bailey on injuries of the brain and spinal cord could be read profitably by all physicians. The chapter on transportation of the injured is the most concise, readable discussion for the layman of this topic that has come to the reviewer's notice.

The book will serve admirably its stated primary purposes as a textbook for medical students. The illustrations are simple line drawings and are well planned and executed for teaching purposes. The print is easily read and the general make-up of the book is attractive.

ATLAS OF SURGICAL OPERATIONS, by *Elliott C. Cutler, Moseley Professor of Surgery, Harvard University and Chief Surgeon of the Peter Bent Brigham Hospital; and Robert Zollinger, Assistant Professor of Surgery, Harvard University and Senior Associate in Surgery at the Peter Bent Brigham Hospital; illustrated by Mildred B. Coddington.* 181 pages; illustrated. The Macmillan Co., New York, publishers, 1939. Price \$9.

In this seventh printing, 1942, the authors have presented a comprehensive treatise on standard and proven surgical operations. The omission of unessential details is marked. The three chapters on surgical technic, anesthesia, preoperative and postoperative care are excellent.

The subject matter is presented in concise and logical manner. The bold-faced type on the page opposite the plates adds to the clear-

ness and rapidity in following the surgical procedures. However, the anatomical structures could be more adequately identified.

The presence of so many standard surgical procedures in one volume has its merits in time of war by increasing the availability of such information to young medical officers and internes and by eliminating the possibility of the loss of a volume from a set.

WAR AND THE DOCTOR, Essays on the Immediate Treatment of War Wounds, edited by *J. M. Mackintosh, M. D., Chief Medical Officer of the Department of Health for Scotland.* 135 pages. William Wood & Co., Baltimore, Md., publishers, 1942. Price, \$2.

This pocket-size edition comprises a series of lectures on casualty surgery, both civilian and military, delivered at the request of the Edinburgh Branch of the British Medical Association.

The purpose of the book is to present to the medical practitioner, in concise form, a guide for the management of military emergencies encountered on the field and among the civilian population, after air raids.

The book is necessarily lacking in some details but gives an excellent résumé on the management of chest injuries, head injuries, injuries to the face and jaw, and the management of lower limb casualties. It is not intended as a text but a "thumb-nail" sketch of principles, which if followed, will guide the general practitioner in his care of casualties encountered.

An outline for first-aid instruction in wartime will be of aid to those not previously called upon to present lectures of this type.

TRAUMATIC SURGERY OF THE JAWS, Including First-Aid Treatment, by *Kurt H. Thoma, D. M. D., Professor of Oral Surgery and Brackett Professor of Oral Pathology, Harvard University.* 315 pages with 282 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$6.

Maxillofacial injuries, particularly those resulting from war injuries, frequently offer most difficult problems. Today these injuries are largely the responsibility of the oral surgeon.

This text is most excellently illustrated, the numerous photographs and illustrations being the outstanding feature of the book. The chapter dealing with injuries of the condyle and mandibular joint covers this type of injury very completely. The chapter on fractures of the mandible gives an excellent review of the various methods and appliances used in immobilizing these fractures. The illustrations on this subject are particularly good.

More space should have been devoted to discussion of first-aid treatment, anesthesia, and chemotherapy; as these phases of treatment are of paramount importance.

The printing is excellent and the binding of good quality.

A MANUAL FOR THE DIFFERENTIAL DIAGNOSIS OF ORAL LESIONS, by *Joseph L. Bernier, D. D. S., M. S.; Major, Dental Corps, U. S. Army; Curator, Dental Division, Army Medical Museum, Washington, D. C.* 228 pages; 174 text illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$4.

The subject matter is treated concisely and is an accumulation of much clinically diagnostic and treatment material published in other texts. For this reason it may serve as a compend and as such can be recommended for average clinical and microscopic diagnosis of oral lesions.

Most of the photomicrographs are excellent and the C. V. Mosby Co. is to be commended for their faithful reproduction.

TEXTBOOK OF NERVOUS DISEASES, by *Robert Bing, Professor of Neurology, University of Basel, Switzerland*; translated and enlarged by *Webb Haymaker, Assistant Clinical Professor of Neurology and Lecturer in Neuro-anatomy, University of California*, from the fifth German edition. 838 pages with 207 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$10.

This is a well-presented book of standard approach to problems of nervous system disorders, which, while it offers nothing particularly new or startling in this field, nonetheless collects the available material in good readable form. Illustrations are adequate in number, well related to the text, and of good content. Under all headings, much more space is devoted to treatment than is usual in textbooks, and this is most commendable. The extensive bibliography on each subject also is worthy of special mention.

Unlike most textbooks on this subject, this book carries no extensive section on anatomy, which is not considered an objection to it. Anatomy is covered in connection with the various system disorders and diseases. The chapter on aphasia is especially well presented, and the section on syphilis, convulsive disorders, and headache are quite well done. The psychoneuroses are dealt with entirely from a descriptive point of view, and this section adds nothing to the total book. In general, the book is a good one and should be seen by those interested in this special field.

PSYCHOBIOLOGY AND PSYCHIATRY, A Textbook of Normal and Abnormal Human Behavior, by *Wendell Muncie, M. D., Associate Professor of Psychiatry, Johns Hopkins University*; with a foreword by *Adolf Meyer, M. D., LL. D., Sc. D., Henry Phipps Professor of Psychiatry and Director of the Department of Psychiatry, Johns Hopkins University*. 739 pages with 69 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$8.

This book presents the teachings of Dr. Adolf Meyer, the "Dean of American Psychiatry." The author, one of his numerous outstanding pupils, gives the philosophy, principles and scientific basis of psychobiology in relation to modern dynamic psychiatry. The print is easily read, the material is well organized and the facts are recorded

in a fluent style. Part I deals with psychobiology or normal behavior. In these chapters the sentences are at times too long and complicated. Frequently the material is made too difficult to grasp. In general, the contents of the book are presented in a concise and practical manner.

Part II deals with the specific reaction types seen in psychiatry. From a naval psychiatric viewpoint the chapter dealing with psychopathic personalities or "static constitutional types" is too brief. The military importance and frequency of this reaction warrants more space. The new entity, "general nervousness" may exist, but it certainly is not scientific or constructive. The chapter dealing with depressive and schizophrenic reactive types is excellent. The various classifications and formulations are presented in a dynamic and practical fashion. Part III which deals with psychiatric treatment is brief but to the point. He emphasizes the analysis of all the facts pertinent to the life study of each individual. Hence personality evaluation and synthesis will vary according to each patient's needs. Part IV of the book deals with the historical bibliography of the various types of illnesses. This is excellent, because the various contributions and changing concepts throughout the years are easily followed. With the excellent references it shows the development of modern psychiatric concepts.

The book accomplishes its purpose. The modern psychobiological school of psychiatry is expressed. To those interested in psychiatry and neurology it is an essential addition. For physicians in the Medical Corps it would help them deal with some of their many problems. It is a textbook with excellent references and should be a part of any modern medical library.

ROENTGEN TREATMENT OF DISEASES OF THE NERVOUS SYSTEM, by *Cornelius G. Dyke, M. D., F. A. C. R., Associate Professor of Radiology, College of Physicians and Surgeons, Columbia University; and Leo M. Davidoff, M. D., F. A. C. S., Chief, Department of Surgery, Attending Neurological Surgeon, Jewish Hospital of Brooklyn.* 198 pages; illustrated with 12 engravings, 7 charts and 16 graphs. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$3.25.

"Roentgen Treatment of Diseases of the Nervous System" is a detailed summary in English of the literature on the subject and the reports of the experience of the radiologists interested in this branch of radiotherapy. It deals with the effects of radiation on the central and peripheral nervous systems and on the diseases of these structures. The authors' experience is limited to the use of roentgen radiation, but the effects of radium irradiation on the nervous system and diseases affecting it is presented as reported by others.

This volume should serve as a useful guide to every practitioner of radiotherapy. It is well written, clear and concise.

THE PRINCIPAL NERVOUS PATHWAYS, Neurological Charts and Schemata with Explanatory Notes, by *Andres Theodore Rasmussen, Ph. D., Professor of Neurology, Department of Anatomy, University of Minnesota, Medical School, Minneapolis, Minn.* Second edition; 73 pages. The Macmillan Co., New York, publishers, 1942. Price \$2.50.

This book, as the title indicates, is a monographic atlas of the principal nervous pathways. The chief contribution of this, the second edition, is a reorientation of the course and relationships of the lateral spinothalamic tract. More detailed knowledge of localizations within the diencephalon, especially in relation to the thalamic nuclei, is added. The proprioceptive and vestibular systems and their connections with the cerebellum have been clarified and elaborated.

It is a pedagogic book, accurate and useful, especially to students and neurologists.

PSYCHOTHERAPY IN MEDICAL PRACTICE, by *Maurice Levine, M. D., Attending Psychiatrist, Cincinnati General Hospital.* 320 pages. The Macmillan Co., New York, publishers, 1942. Price \$3.50.

The reviewer unqualifiedly recommends this compact volume as an indispensable guide to general practitioners, advanced medical students, and the many psychiatrists who may be in need of recrystallizing their knowledge in this difficult field.

Between its covers is contained an extraordinarily lucid and thorough summary of the most useful and generally applicable psychotherapeutic procedures now employed by those most competent to evaluate them.

Since Dr. Levine is obviously well grounded in both psychopathology and clinical neurology, he draws freely upon these basic subjects in order to establish a sound background for the description of psychotherapeutic technics. In so doing he clearly indicates the advantages, limitations, and pitfalls attendant upon each, thus pointing the way to the most advantageous approach to any individual psychotherapeutic problem.

This book deserves a place in the library of every medical man who wishes to exert his maximum effort in alleviating human suffering. Thus the surgeon, internist, and medical specialist can well afford to assimilate the essence of its contents, and will thereby acquire a point of view, if nothing more, which cannot fail to render more satisfactory his relationship with his patients.

The book's topography and general format leave nothing to be desired.

AFTEREFFECTS OF BRAIN INJURIES IN WAR, Their Evaluation and Treatment. The Application of Psychologic Methods in the Clinic, by Kurt Goldstein, M. D., Clinical Professor of Neurology, Tufts Medical School. 244 pages. Grune & Stratton, New York, publishers, 1942. Price \$4.

Dr. Kurt Goldstein is one of those refugees from Nazi barbarism whose loss to Hitler's Third Reich is America's gain. His small volume on "Brain Injuries" represents the fruit of his many years of experiences, original thinking and creative experiments along this line since World War I.

The volume consists of 223 pages and an extensive bibliography as well as an index. There are two parts to the book, the first dealing with symptomatology, the second with treatment. The part on symptomatology is subdivided into chapters on general, neurological, and mental symptoms. In these chapters the author avails himself frequently of generalizations to which others in the field might well take exception. This is particularly applicable to the chapter on the origin of symptoms where the author finds a fertile field for theoretical formulations, characterized by creative thinking and original ideas, which introduce a stimulating as well as controversial note into the field. For the beginner especially, but even for the more experienced practitioner in the field, this is a particularly fruitful chapter.

What lends the book its special value is the portion dealing with treatment. In this connection the informative chapter on psychologic laboratory examinations should be read. The carefully detailed exposition on retraining, as well as on psychological and social therapy, should be of particular use in any hospital where the rehabilitation of the brain injured is undertaken.

ENCEPHALITIS, A Clinical Study, by Josephine B. Neal, A. B., M. D., Sc. D., F. A. C. P.; Associate Director, Bureau of Laboratories, Department of Health, New York; Clinical Professor of Neurology, College of Physicians and Surgeons, Columbia University; and collaborators. 563 pages; illustrated. Grune & Stratton, New York, publishers, 1942. Price \$6.75.

This is an excellent and timely work. The author has an extensive clinical and research background in epidemic encephalitis and its residuals, and has incorporated her knowledge in a volume which must be considered an authority. The majority of the book is devoted to epidemic encephalitis (von Economo), as is to be expected, since this type constitutes the major clinical problem among the encephalitides. Other types of encephalitis are given appropriate space.

Epidemic encephalitis is attacked thoroughly from all angles: Epidemiology, pathology, clinical course, treatment, and residuals, both neurological and psychiatric. At the present time, with similar world-wide conditions existing as were present when this disease made its initial bow, it is most important that all Naval medical officers be

thoroughly familiar with this subject. No better source of information is available than this compact, well written, and excellent book.

WAR MEDICINE, A Symposium, by The Philosophical Library, Inc., New York City. *Winfield Scott Pugh, M. D., Commander, (MC), U. S. Navy, Retired, Editor; Edward Podolsky, M. D., Associate Editor; Dagobert D. Runes, Ph. D., Technical Editor*, 565 pages; illustrated. F. Hubner & Co., Inc., New York, publishers. 1942. Price \$7.50.

This is a symposium on war medicine made up of articles previously published in *The Military Surgeon*, *The British Medical Journal*, *American Journal of Surgery* and other periodicals. Practically all branches of the subject are included and in many instances the actual experiences of the authors under war conditions increases the interest to the reader.

Considerable space is devoted to the surgery of war wounds. The editors have allowed some overlapping and repetition of material in this field by the various authors. The section on aviation and naval medicine contains several interesting articles on the effects of high altitudes on flyers and ocean depths on divers. The section on general medicine touches on such subjects as nutrition, malingering, allergy, and even chigger bites.

CLINICS, Volume I, Number 1, June 1942, edited by *George Morris Piersol, M. D., Professor of Medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia, Pa.*, with the collaboration of 16 prominent medical men. 264 pages; illustrated. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$12 per year. Published bimonthly.

This bimonthly publication, pocket size, in paper binding, replaces the former *New International Clinics* issued quarterly. This most recent Lippincott publication is not entirely a new edition, but rather a renovation and streamlining of one that has for years brought to the profession both the "new and the tried" in medical knowledge and scientific advances wherever found.

The rapid progress of medicine on the home and foreign fronts has necessitated a medium which could respond to this increased tempo of medical progress by reports coming at shorter intervals and from a variety of medical centers. This publication will bring brief "clinics" and original contributions in the various fields of the medical sciences. The plans to present original contributions in the form of symposia will be an added attraction for those who enjoy coordination of reports presented simultaneously on closely allied subjects.

The premiere number speaks well for the planning and thought which must of necessity have preceded the presentation of such an excellent number; with the symposium on burns and shock as apropos of present-day needs and interest as any which might have been selected.

The general practitioner may do well to consider this publication on his "must" list of "home" postgraduate education.

ADVANCES IN INTERNAL MEDICINE, by 11 contributors, edited by J. Murray Steele, M. D., Welfare Hospital, New York University Division, Welfare Island, N. Y. and 7 associate editors. 292 pages. Interscience Publishers, Inc., New York, publishers, 1942. Price \$4.50.

In his preface to this new contribution in the field of internal medicine the editor expresses the wish that the volume will fulfill its mission of presenting material in which recent progress has been made, written by individuals who have themselves contributed to this progress and presented in a style sufficiently simple and broad, and at the same time sufficiently detailed that it will appeal not only to those whose interest lies outside the particular field discussed but also to those working in that field.

The reviewer believes that this ideal has been attained in this volume. It is a book of convenient size, with large, clear, easily readable type, well bound and well indexed.

There are eleven contributions in this first volume covering a wide range of investigation in the field of internal medicine. The eleven authors occupy prominent places in their own particular fields and have contributed largely to the recent advances in the subject discussed.

Worthy of especial commendation is the excellent bibliography attached to each contribution, containing in one instance as many as 202 up-to-date references. The style for the most part is interesting and very readable. The reader is brought up to date in a practical, concise manner in eleven different fields of medicine, each one of which has not yet been exhausted and the vista of still further progress in each field is opened to him. The reviewer can heartily recommend this book.

THE WAR OFFICE MEMORANDA ON MEDICAL DISEASES IN TROPICAL AND SUB-TROPICAL AREAS, reprinted by permission of the *Controller of His Britannic Majesty's Stationery Office*. First American edition. 282 pages; illustrated. Chemical Publishing Co., Inc., Brooklyn, N. Y., publishers, 1942. Price \$4.75.

The first American Edition, 1942, is the sixth edition published by the British War Office. This handbook of 282 pages is not intended as a textbook but is rather a precis which has been designed to meet the needs of those physicians who are unfamiliar with the subject and have little time to prepare themselves for duty in the tropics or to care for returning service men ill with one or more of the exotic diseases.

As a compendium of the etiology, transmission, and prevention of the more important tropical diseases the book is excellent.

For some diseases the sections on treatment either seem out of date or in disagreement with what is generally considered the best practice in the United States. To mention only two instances: In ankylostomiasis carbon tetrachloride has not been generally recommended by authorities on this side of the Atlantic for several years and has been abandoned for safer and equally effective drugs. Thymol also has not been used or recommended for even a longer period. Considerable space is given to both these drugs whereas hexylresorcinol is not even mentioned. In the article on bacillary dysentery sulfaguanadine is not mentioned. The saline treatment is still recommended. In this country such treatment is considered by many to be actually harmful to an already damaged intestinal mucosa. With the enormous loss of body fluids through the bowel in such cases an added drain does not seem rational. However, many of our own accepted textbooks still recommend this same treatment. It would seem that now, if ever, is the best time to part with some of our old ideas in the interest of more rational treatment and less hidebound respect for tradition.

The articles on malaria, blackwater fever, heat stroke, leishmaniasis, and sleeping sickness are excellent.

It is understood that this book sells for less than \$1 in England. Certainly it would seem that the price of \$4.75 for the American edition is exorbitant.

PAIN, by Thomas Lewis, M. D., F. R. S., *Physician in Charge of Department of Clinical Research, University College Hospital, London*. 192 pages. The Macmillan Co., New York, publishers, 1942. Price \$3.

To observe that pain is the commonest single clinical symptom, and is the chief mechanism by which the individual is made aware of something wrong in his body, seems hopelessly trite. Nevertheless, a knowledge of the physiology of pain production, with the resultant ability to evaluate correctly and interpret its significance remains one of the most important diagnostic assets of the clinician.

This monograph by a distinguished authority attempts to bring an entirely subjective phenomenon into the realm of scientific objectivity. In a concise manner the modern concepts of pain production are reviewed, together with the author's well controlled observations on human subjects; the evidence is correlated and discussed, with well chosen examples of various types of pain.

The volume is handy in size, the text is easily readable, and the illustrations, while few, are clear and well prepared. Special commendation should be given to the bibliography reference numbers in the text, which are large and more readily visible than in the usual medical volume.

HUMAN PATHOLOGY, by *Howard T. Karsner, M. D., Professor of Pathology, Western Reserve University, Cleveland, Ohio.* 817 pages; 460 illustrations. Sixth edition, completely revised and reset. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$10.

The fact that this textbook of human pathology has been carried through six editions since its first appearance in 1926 attests to its merit and wide usage as well as the interest of the author in keeping it up to date. It has always served as one of the standard textbooks of pathology.

The present edition is a nicely bound volume of 817 pages. The type is large and clear with two columns of print on each page which facilitates reading. The illustrations are well selected and the publishers are to be complimented for the excellence of their reproduction. One of the very useful features of the book is the well selected and up-to-date bibliography at the end of each chapter. Most of the references are to well-chosen articles in English which should appeal to those having no facility in reading foreign languages.

Most of the text has been extensively revised and brought up to date with much new material having been added, particularly in the chapters dealing with vitamin deficiencies, edema and shock, virus and rickettsial diseases, etc. This book should be of interest to the clinician as well as to the pathologist since the author has endeavored to interpret functional and pathologic disturbances in terms of clinical manifestations.

OUTLINE OF HISTOLOGY, by *Margaret H. Hoskins, Ph. D., and Gerrit Bevelander, Ph. D., Departments of Anatomy, College of Dentistry and the Graduate School of Arts and Science, New York University.* 300 pages; illustrated. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$2.50.

This book is exceptionally well written for the student and scattered throughout are blank pages for notes. The drawings and the pictures of the various subjects presented are well defined, clear, and leave little to the imagination. The explanations of the subject matter are very well handled, and are clear and concise. The material used is not extensive, yet sufficiently inclusive to give the student everything he should learn about the subject discussed.

WAR GASES, Their Identification and Decontamination, by *Morris B. Jacobs, Ph. D.* 180 pages. Interscience Publishers, Inc., New York, publishers, 1942. Price \$3.

Now more than ever, the problem of defense against chemical warfare agents assumes paramount importance, and the appearance of this compact, well-written reference handbook on the war gases is therefore very welcome. However, from the standpoint of a medical

officer, this compend is somewhat limited inasmuch as it concerns itself primarily with the physical and chemical properties of war gases and very little concerning the pharmacological or pathological aspects of chemical warfare agents.

War gases as treated by Dr. Jacobs is approached entirely from the point of view of the analytical chemist. The work and material is accurate and the review of the literature is complete.

This book fills a very definite need in the field of chemical warfare, but probably is better adapted to the use of nonmedical gas officers such as those interested in civilian defense work rather than for medical officers trained in chemical warfare.

BIOCHEMISTRY OF DISEASE, by *Meyer Bodansky, Ph. D., M. D., Director of the John Sealy Memorial Laboratory and Professor of Pathological Chemistry, University of Texas School of Medicine; and Oscar Bodansky, Ph. D., M. D., Lecturer in Biochemistry, Graduate Division, Brooklyn College.* 684 pages. The Macmillan Co., New York, publishers, reprinted 1941. Price \$8.

The authors need no introduction in the field of biochemistry. Their textbooks have been standard for years in many medical schools. This book is pertinent to the physician because of its systemic arrangement of biochemical material in accordance with clinical entities. The medical student often fails to correlate his laboratory training in biochemistry fundamentals with clinical diseases in later years. The Bodanskys have bridged this gap and have endeavored to lead to a better understanding of the pathogenesis, course, and treatment of various diseases.

The book covers all medical biochemistry including the more recent fundamental investigations in the biochemistry of disease. Chapters cover diseases of the blood, the more pertinent organs, ductless glands, nutrition, metabolism, and even aspects of neurologic and psychiatric disorders. Unlike most monographs and texts of this type, laboratory methods are either left out or reduced to a minimum. The text is easily readable and of a more flowing style than the majority of books on similar subjects. Few formulas are represented, and are understandable to the average doctor. Most of the illustrations are interesting because of their simplicity. The book is bound in a firm dark cloth binding in keeping with the dignity of the subject. A complete bibliography finishes each chapter.

This book is applicable to all the special branches of medicine as well as to the general practitioner. The hematologist, the urologist, and the obstetrician can likewise find valuable reference, not to mention the metabolist and the psychiatrist. A valuable book for review and reference on this rapidly expanding field of medicine.

MEDICAL CLIMATOLOGY, Climatic and Weather Influences in Health and Disease, by *Clarence A. Mills, Ph. D., M. D., Professor of Experimental Medicine, University of Cincinnati*. 296 pages with 90 figures. Charles C. Thomas, Springfield, Ill., publishers, 1939. Price \$4.50.

This book presents a well written and arranged volume dealing with climatic and weather influences in health and disease. The effects of climate during the entire life span from conception to death are analyzed and are related to the energy characteristics of mankind in terms of geographic and racial distribution.

Despite the author's modest statement to the contrary, he obviously has reviewed and analyzed a great mass of statistical data and voluminous literature in order to present summaries of other studies and to make deductions.

Descriptions of world climates and meteorology together with storm track maps, temperature charts and graphs are given. Statistics are used to demonstrate that certain factors contributing to growth and development, fertility, disturbance of metabolism, infectious diseases, sclerosis, circulatory failure, mental diseases, and dental caries are related to climate. A chapter on the therapeutic application of natural and artificial climates is included.

The volume may have a greater appeal to the student of public health and preventive medicine than to the practicing physician and the material is presented in a form that should be grasped by the non-medical reader.

NUTRITION AND DIET THERAPY, A Textbook of Dietetics, by *Fairfax T. Proudft, Instructor in Nutrition and Diet Therapy, University of Tennessee College of Medicine*. Eighth edition; 1,069 pages. The Macmillan Co., New York, publishers, 1942. Price \$3.25.

The requirements of a textbook in normal nutrition and diet therapy seem to have been well met in this edition in that it is practical, usable, and scientifically sound.

The first part of the book is devoted to normal nutrition which deals with food nutrients, their composition, functions, and sources.

The greater portion of the book is devoted to abnormal conditions and treatment by diet therapy. Of special value to both the doctor and the hospital dietitian is the complete outline on routine hospital diets giving the characteristics of the diet and the modifications in the normal diet used. Samples of special diets are also worked out in detail.

An excellent food value chart and proximate composition of American food materials are included in the appendix.

SURGICAL NURSING, by *E. L. Eliason, A. B., M. D., Sc. D., F. A. C. S.; L. Kraeer Ferguson, A. B., M. D., F. A. C. S.; and Evelyn M. Farrand, R. N., B. S.* Sixth edition; 662 pages with 244 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.25.

This is an excellent book on surgical nursing. All of the surgical procedures are fully and comprehensively described. It has splendid charts and illustrations for further elucidation of pertinent paragraphs.

There is a chapter on "Antiseptics and Asepsis," which is presented in such a manner as to eliminate the usual confusion with which the student begins study of this subject.

Various types of anesthesia are briefly presented, since it has an inseparable place in all considerations of surgical nursing.

Almost every chapter of the book ends with "References and Suggested Readings" for further study of the subject matter.

SIMPLIFIED NURSING, by *Florence Dakin, R. N., Former Inspector of Schools of Nursing, State of New Jersey; and Ella M. Thompson, R. N., B. S., Assistant Director, Practical Nurse Training, Ballard School, Young Women's Christian Association of the City of New York.* 444 pages with 80 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$2.

This book is designed for practical nurses and the teaching of practical nursing. All procedures are presented in a clear and simple manner with excellent illustrations to assist the student in understanding the basic principles of routine nursing care.

There are explicit directions for making the commonly prescribed solutions with the quantity of the drug for a given amount of solution stated. The administration of medications is stated in a clear and concise manner, readily understandable to the type of student for which this book is intended.

"Simplified Nursing" is undoubtedly used for class work in some of the many schools which have been organized for this type of training.

PROFESSIONAL ADJUSTMENTS IN NURSING, For Senior Students and Graduates, by *Eugenia Kennedy Spalding, R. N., M. A., Nursing Education Consultant, States Relation Division, U. S. Public Health Service, Federal Security Agency.* Second edition; 560 pages with 30 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$3.

This book is designed, as is stated on the cover, to help nurses make professional adjustments. It presents excellent material for a study of all the professional branches of nursing for purposes of orientation to and delineation of vocational opportunities. It should be, and probably is an invaluable addition to every nursing school library, and used in the classes designed for this phase in the nurse's education. There are excellent bibliographies and references.

All of the government services are presented to the nurse who is interested in this type of duty. However, the material on the Army Nurse Corps and Navy Nurse Corps is no longer up to date because legislative processes have made changes for nurses in these services. At the time this book was written the war expansion, with increased demands on the nursing profession, was undeveloped, and the exigencies of current military needs could not possibly be anticipated by the author.

EMERGENCY CARE, by Marie A. Wooders, B. S., R. N., Principal, School of Nursing, Hackensack Hospital, Hackensack, New Jersey; and Donald A. Curtis, M. D., Lieutenant-Colonel, Medical Reserve, Commanding 342nd Medical Regiment, United States Army; Instructor in Military Nursing, Hackensack Hospital, Hackensack, New Jersey. 560 pages with 201 illustrations. F. A. Davis Co., Philadelphia, Pa., publishers, 1942. Price \$3.50.

The title well describes the contents of this book which appears to meet the aim of the authors to provide a manual for the instruction of civilian nurses in first-aid and emergency care, so essential in the present emergency, and thereby better fit them to render efficient nursing care in the military services.

The authors have presented an excellent text on emergency care, the style of printing provides easy reading, and the illustrations help with a clear understanding of the text.

This work is well suited as a textbook for teaching both student and graduate nurses, and should be a valuable aid to civilian nurses in the performance of their duties.

THE PROSPECTIVE MOTHER, A Handbook for Women During Pregnancy, by J. Morris Slemons, M. D., Sometime Associate Professor of Obstetrics, Johns Hopkins University, Professor of Obstetrics and Gynecology, University of California and Yale University; with a chapter on the Care of the Newborn by Phillip E. Rothman, M. D., Professor of Clinical Pediatrics, University of Southern California. 274 pages; illustrated. Fourth edition. D. Appleton-Century Co., Inc., New York, publishers, 1942. Price \$2.50.

This book, entitled a handbook for women, might well stand next to the textbook of obstetrics on the shelf of the student of obstetrics and might serve as a supplement to the study as well as a foreword and preface.

It is an expansion of the frequent few-paged chapters on prenatal care in many texts and contains a readable and concise adaptation of some of the difficult obstetric factors such as embryology.

Busy practitioners might do well to distribute several copies of the book so that each new prospective mother would be an easier and more cooperative patient.

THE DIVISION OF PREVENTIVE MEDICINE

Commander T. J. Carter, Medical Corps, United States Navy, in charge

THE STERILIZATION OF WATER MAINS

LEONARD J. GOLDWATER ¹

Lieutenant Commander (MC) U. S. N. R.

and

AUSTIN N. HELLER ²

Ensign, H-V(S), U. S. N. R.

The provision of a safe supply of fresh water in naval shore establishments involves the joint responsibility of the public works officer and the medical officer. The former is concerned with the actual mechanical procedure of laying water mains and providing necessary connections and services, while the latter is charged with testing the sanitary quality of the water and interpreting the results of bacteriological examination in terms of potability.

There are two principal situations in which the sterilization of water mains is an important and necessary procedure: (1) When new mains are to be placed in service; and (2) when existing mains become polluted. Pollution may occur as a result of cross connections between a potable and a nonpotable water; it may be the result of a rupture in the pipe or it may occur as a result of external violence such as a bomb explosion. Few people realize the far reaching effects which sudden interruption of a fresh water supply can have both on health and on industrial activity.

At the present time most of the older naval establishments are undergoing rapid expansion and at this yard many new construction projects are underway. During this period of growth it has been one of the functions of the medical department to see that all drinking water was of proper sanitary quality, thereby preventing any outbreaks of water-borne gastro-enteritis. It was necessary to accomplish this without occasioning any interruption in the water supply in any part of the Yard.

It is obvious that the basis for judging the sanitary quality of water is the bacteriological examination for members of the coli-aerogenes

¹ Industrial Health Officer, U. S. Navy Yard, New York, N. Y.

² Assistant Industrial Health Officer, U. S. Navy Yard, New York, N. Y.

group. Many so-called simplified methods of studying the bacterial flora of water have been devised. These methods may be quite misleading, consequently it is desirable where possible to adhere to the accepted Standard Methods of Water Analysis, as promulgated by the American Public Health Association. These methods were followed implicitly in conducting the investigations which form the basis for this report.

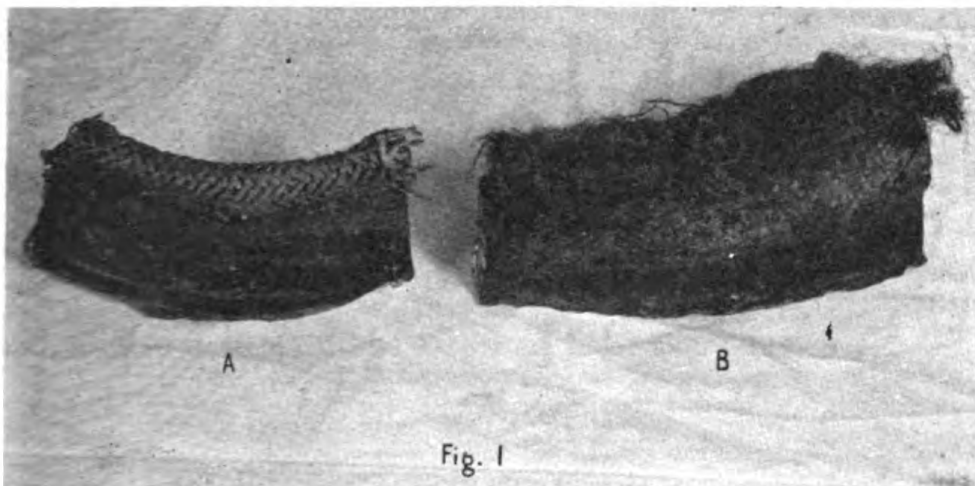
The importance of sterilizing newly laid water mains has been realized for at least 25 years (1). It is only since the introduction of modern methods of warfare that the problem of sterilizing mains which have been ruptured by external violence has attracted very much attention. Up until the past few years most water authorities have felt that if a potable water was delivered from the purification plant there was little need for further concern. At the present time increasing emphasis is being placed on the necessity for controlling conditions throughout the entire distribution system.

The earliest and simplest method of reducing contamination in new or in polluted water mains was to flush repeatedly and depend on the mechanical action of flowing water to remove contamination. This method is of questionable efficacy. Actual sterilization has been attempted by the use of chlorine compounds or chlorine gas. One method consists in placing a calculated quantity of chloride of lime or calcium hypochlorite in the main which is to be treated, allowing water to flow into the main, thus dissolving the chlorine compound, closing off both ends of the line and allowing the solution to remain in contact with the pipe for periods ranging from several hours to several days. A more recent development has been the substitution of dissolved chlorine gas for the solid materials, the other parts of the procedure remaining the same. None of these methods has given satisfactory results (2) (3). It has been found that within as short a time as 1 hour after the heavily chlorinated water was flushed out, the water flowing through the mains did not meet standards for potability even though the water entering the system was potable (4).

Application of these so-called batch or slug methods of chlorination has other disadvantages in addition to lack of efficacy. Perhaps the most important is the necessity for suspending service in the lines which are being treated. Since these methods depend upon water under pressure remaining in the mains during the contact period, obviously no water can be withdrawn during this time. Even the inadvertent opening of a hydrant or faucet or the flushing of a toilet may upset the entire procedure. Operations of vital importance in both military and civilian establishments may have to be suspended because water is not available.

THE PROBLEM OF AFTERGROWTH

By aftergrowth is meant those bacteria which are found in a water after it has entered a distribution system and which presumably were not present in the water as it was delivered from the purification plant. If a water as it enters a distribution system meets standards for potability and at some point in the system is found to fall below these standards, obviously the contamination must have occurred somewhere within the water lines. Assuming that the possibility of cross connections has been eliminated and that all foreign matter that may have entered the water mains during the process of laying has been effectively flushed out, there still remains at least one potential source of contamination. This is the calking material which is used in pipe joints preparatory to sealing the joints with lead.



1. COMPARISON OF CHEMICALLY TREATED PAPER (A) WITH HEMP BRAID MATERIAL (B) USED IN THE CALKING OF WATER MAINS.

The most commonly used calking material at the present time is jute or hemp braid sometimes referred to as yarn, oakite, or oakum. It is not generally known that certain types of oakum are cured by being retted in manure. Such material can and does contribute liberally to the bacterial flora in newly laid water mains. Furthermore, even if the oakum were sterilized prior to use and were applied under aseptic precautions (a patent impossibility under field conditions), the material itself is capable of supporting growth of coliform bacteria (1) (2) (3). Consequently any bacteria circulating in a water main may find comfortable lodging, with food available, at any one of the joints in a water main. Figure 1B gives some idea of the appearance of hemp braid packing as found in a joint actually removed from a water main.

There is considerable evidence to indicate that oakum calking material is one of the principal factors involved in bacterial aftergrowths.

This fact is of more than academic importance, since our most reliable criterion of potability is bacteriological analysis, particularly as related to members of the coli-aerogenes group, and since oakum can be a source as well as a supporter of growth of these organisms. Whenever oakum is present in new water mains it is impossible to tell whether the high coli-aerogenes indices are due to the oakum or to external pollution. Consequently evidence of contamination from without may be masked by bacteria growing within the water system.

In an effort to avoid some of the difficulties introduced by the use of hemp braid calking an investigation has been made of substitute materials. It was found that there was on the market a chemically treated paper calking material which seemed to offer definite possibilities. After preliminary laboratory testing of this substitute material, a recommendation was made to the public works officer at the New York Navy Yard that the paper calking be tried in small sections of a new fresh water main to determine its suitability from a purely technical point of view. When the new material was found to be satisfactory in this respect it was used exclusively in an isolated 400-foot section of new water main. Sterilization of this small section was accomplished so readily that further large scale use of the substitute material was instituted. At the present time the use of oakum has been discontinued and the paper calking is being used exclusively. The appearance of this material in an actual section of pipe is shown in figure 1A.

An excellent opportunity to compare oakum with paper calking was presented when two identical new sections of water main were laid. In one of these, oakum was used, in the other the calking was done entirely with the substitute material. The essential details in connection with sterilization are shown in table 1. It can be seen that when hemp braid (oakum) was used for calking it required two 24-hour treatments with sufficient chlorine to produce a residual of 2 to 3 p. p. m. to produce a potable water. When chemically treated paper calking was employed, a single 24-hour application of a much lower concentration of chlorine resulted in effective sterilization of the water mains.

TABLE 1.—*Effect of calking material on sterilization of newly laid water mains*

Calking material	Length of pipe in feet	Diameter of pipe in inches	Number of chlorine treatments	Total contact time in hours	Chlorine residual (HOCl) p. p. m. ³	Coli-aerogenes indices ¹	
						Before	After
Hemp braid.....	3,000	8	2	48	2-3	>240	4.0
Substitute (chemically treated paper).....	3,000	8	1	24	0.5-1.0	240	<2.0

¹ Subsequent examination revealed a potable water, i. e., <2.0.

² Standard Methods of Water Analysis, B. G. B. used as confirmatory medium.

³ Ortho-tolidine "flash" reaction.

EFFECTIVE CHLORINATION

An attempt has been made to indicate briefly a few of the problems involved in the sterilization of fresh water mains. It would seem that some of the difficulties may be removed if a substitute material such as that mentioned above is used in place of hemp braid for calking. At best, the sterilization of a water main, new or old, is not a simple procedure. Perhaps the simplest part of the entire process is the actual introduction of the sterilizing agent into the pipes.

Before any sterilizing procedure is attempted it is extremely important to have certain fundamental information about the water to be treated:

1. *pH*.—The effectiveness of chlorination is directly related to the pH of the water. Waters which are naturally hard tend to have a high pH; in other words hard waters are usually alkaline. Such waters generally require higher dosages of chlorine for effective sterilization than do acid waters (low pH). The germicidal efficiency of chlorine compounds used for water purification is probably highest in waters having a range of pH 6.0 to pH 8.0 under comparable conditions. When the pH is above 8.0, higher concentrations of chlorine are required. Waters having a pH below 6.0 are relatively uncommon. In the acid range it is ordinarily not necessary to increase chlorine dosages in order to accomplish sterilization.

2. *Mineral content*.—This is directly related to the chemical characteristics of the water, since hardness is ordinarily a function of the presence of calcium and magnesium ions. Therefore a water containing relatively large amounts of these ions will tend to have a high pH and consequently require appropriate chlorine dosage. Iron and manganese will probably not influence the germicidal efficiency of chlorine but may interfere with the reaction of the chemicals used to test chlorine concentrations. This point will be discussed more fully later on.

3. *Organic content*.—In the presence of organic matter, the addition of chlorine and chlorine compounds results in the formation of (a) chlorination and (b) "oxidation" products. The germicidal efficiency of chlorination products such as chloramines or protein-chloro complexes is very much less than that of the oxidation product HOCl (free chlorine residual). Consequently a water having a high organic content requires more chlorine than a water with a low organic content.

4. *Initial bacterial load*.—In general a heavy initial bacterial load will require larger doses of chlorine or a longer contact period than is required when smaller numbers of bacteria are present. Almost invariably a heavy bacterial load is associated with a high organic content. The nature of the bacterial flora is also important. Certain lactose fermenting spore-formers have been found to be highly resistant to chlorine and if these are present in appreciable numbers it is perhaps desirable to increase the dosage of chlorine and length of contact period.

5. *Turbidity*.—A turbid water is one which contains appreciable quantities of suspended or colloidal material. This material may be organic or inorganic. It is very difficult if not impossible to produce a safe water by chlorination alone if the water to be treated has a high turbidity. Some form of filtration must be used prior to chlorination if satisfactory results are to be obtained. The adsorption and absorption of chlorine by suspended substances contribute largely

to this difficulty. Clumps of bacteria may find protection in suspended particles of organic matter.

6. *Temperature*.—The effect of temperature in the chlorination of water is the same as in any chemical or biological reaction. Within limits the higher the temperature, the more rapid the reaction and conversely, the lower the temperature the slower the reaction. This factor probably does not have to be considered unless the temperature of the water is below 40° F.

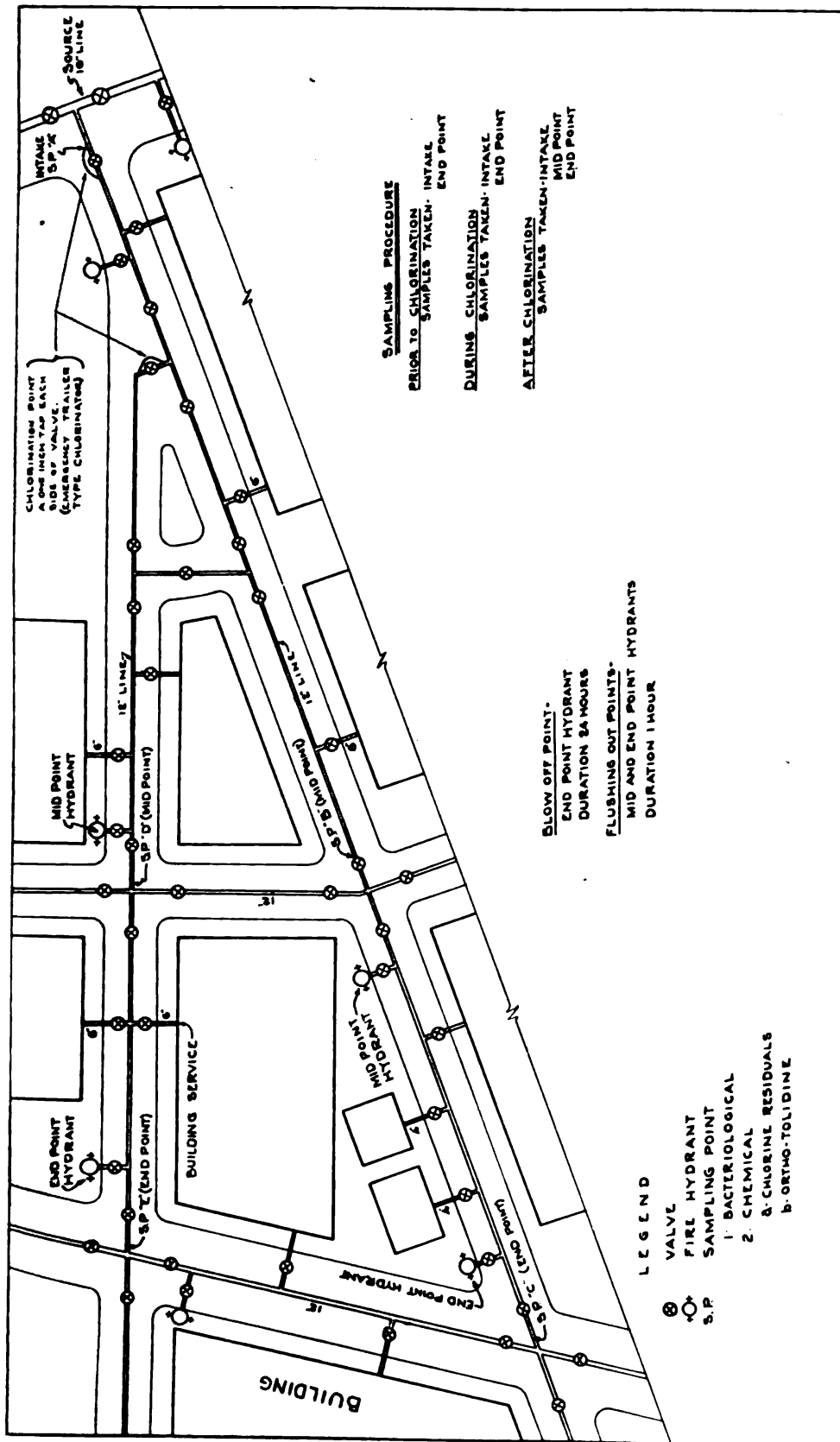
7. *Chlorine demand*.—Waters which contain large amounts of organic matter will have a high chlorine demand. This means that large amounts of chlorine must be introduced to accomplish satisfactory sterilization. As mentioned above organic materials react with chlorine to produce protein-chloro complexes of low germicidal potency. It is not until all organic matter has been "saturated" with chlorine that effective concentrations of the active "oxidation" product HOCl (free chlorine residual) can come into play. This mechanism is the essential feature in so-called break-point chlorination.

This brief discussion of some of the characteristics of waters has been introduced to emphasize the point that no single formula for sterilizing water mains can be expected to give uniformly satisfactory results under all possible conditions. While the fundamental principles of main sterilization will hold for all types of waters, certain variations in the details of the method will obviously be necessary.

A METHOD FOR STERILIZING WATER MAINS

When one speaks of the sterilization of a water main, what is really meant is the elimination or reduction of members of the coli-aerogenes group to a point where the water passing through the main will be potable according to the standards of the United States Public Health Service. In the strictest sense one does not attempt to perform complete sterilization or killing of all bacteria. In practice the procedure consists in applying a germicidal agent in such a manner that all viable coliform organisms are eliminated from the water main. The most satisfactory germicidal agent in common use is chlorine gas.

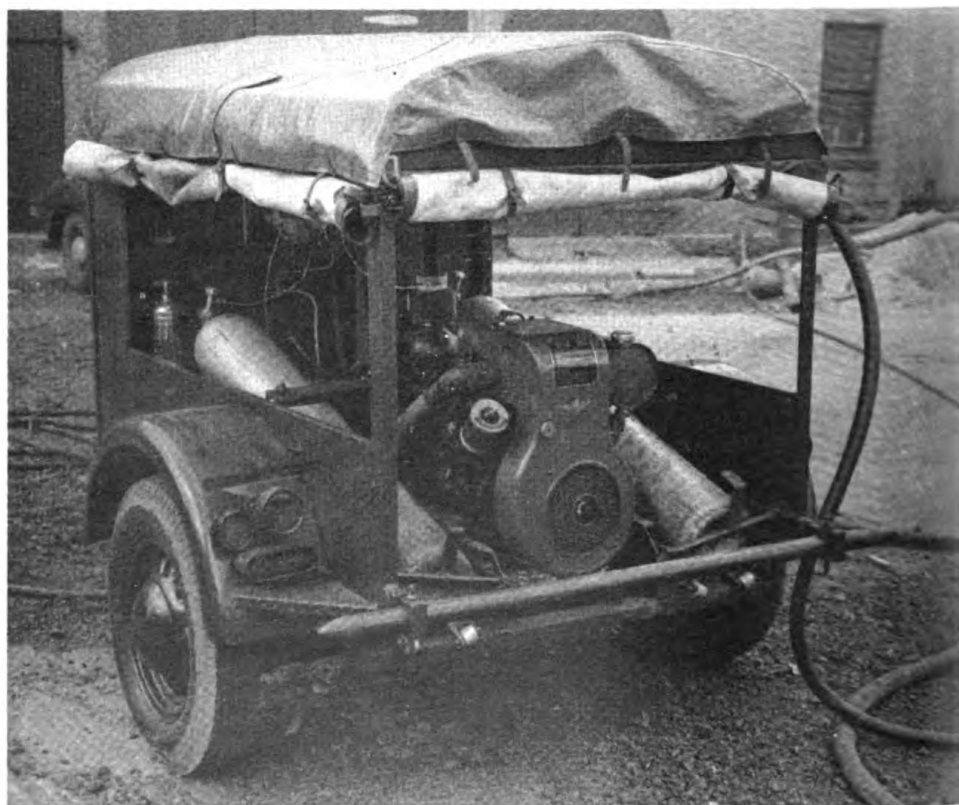
In order to control the results in any sterilization procedure, certain basic facilities are essential. Among the most important of these is a suitable laboratory equipped to determine the physical characteristics described above as well as to carry out standard bacteriological analysis. In some localities the physical properties of the water can be ascertained from the local waterworks authorities. Needless to say, properly trained personnel must be available to perform the laboratory work. A second necessity is a complete and accurate plan of the water piping system showing all connections, hydrants, valves, meter pits, reducers, reducing valves, and size of the mains (fig. 2). If appropriately placed corporation cocks are installed at the time new mains are laid, subsequent chlorinating procedure will be greatly simplified. The third essential is chlorinating equipment. If a stationary chlorinator is to be a part of the permanent water system it can be used for



2. TYPICAL WATER MAIN STERILIZATION OPERATION.

the sterilization procedure, otherwise some type of portable apparatus must be used (fig. 3). A necessary accessory is an ortho-tolidine comparator with a supply of 0.1-percent solution of ortho-tolidine in 10-percent hydrochloric acid for determination of chlorine residuals. Some type of flow meter is valuable but not essential.

Personnel requirements will vary considerably depending on the length and complexity of the main or mains to be sterilized. A line of approximately 3,000 feet at the New York Navy Yard required four mechanics to get the chlorination under way, and two to stand by during the procedure. One of the two operated the chlorinator and the other made tests of chlorine residuals at given points in the system. It is desirable to have one qualified individ-



3. WATER MAIN STERILIZATION EMPLOYING THE EMERGENCY TRAILER-TYPE CHLORINATOR.

ual in charge of the entire process. This person should select the point of chlorination, sampling points for chemical and bacteriological analysis, chlorine dosage, contact time and should direct the opening and closing of valves for routing of the water. In addition he should supervise the bacteriological work and interpret the results. He must be given absolute authority over the water supply until he reports that the sterilization has been completed and the water is potable.

The actual sterilization is accomplished as follows:

1. After a study of the plan of the distribution system, the appropriate valves are adjusted so as to route the water through the sections of pipe to be treated. This should be done if possible in such a way as to avoid interruption of service to noninvolved areas. At this time the point of chlorination is selected and corporation cocks installed if not already present.

2. Select "blow-off" point or points for flushing system. It is essential that all dead ends be flushed. Flushing for 1 hour is usually adequate; however, if the water still appears grossly turbid after 1 hour the flushing must be continued. The suitable rate of flow at "blow-off" points will depend on the water pressure, size of "blow-off" and on available drainage. At end of flushing period, shut all hydrants except the one at the far end of the system. During this period the chlorinator is connected to the system. This is done by suitable connections across a valve by means of corporation cocks. This type of connection facilitates regulation of the chlorine feed and direction of flow.

3. Take samples of water at intake, midpoint and ends of system for bacteriological examination and chlorine content. Hydrants have been found to be unsatisfactory for bacteriological sampling (3), probably due to the fact that the commonly used leather valve seat may act as a source of bacterial growth. Faucets, or taps directly in the water pipe should be used for bacteriological samples.

4. Estimate rate of flow either by meter reading, flow meter or by calculation from size of pipe which is being used for "blow-off." This estimate is used as a guide in selecting the rate of chlorine feed.

5. Inject chlorine initially at such a rate as to attain a free chlorine residual of between 1.0 to 5.0 p. p. m. in the water flowing through the system.

6. Determine chlorine residuals at all sampling points and adjust rate of chlorine feed so that a residual of between 0.5 and 2.0 p. p. m. is present in all parts of the system. For waters having a pH above 8.0 a residual of 1.0 to 5.0 p. p. m. should be maintained. The residuals should be checked every 2 hours.

7. Continue chlorination for 24 hours and shut down chlorinator. This period has been selected arbitrarily and has been found to result in a potable water when chemically treated paper is used as calking material in a new water main. (Investigation is now under way to determine whether this contact time can be reduced). When hemp braid is used for calking or when gross pollution has entered a water main, a second or third 24-hour period of chlorination may be required. The necessity for repeated chlorination will be indicated by the results of bacteriological study following the initial treatment.

8. Allow "blow-off" to flow for a period of 24 hours after shutting down the chlorinator.

9. Test chlorine residuals every half hour at end point in system until residuals disappear. In practice this will ordinarily be within 2 hours after chlorination has been suspended.

10. Take samples for bacteriological examination 1, 6, 12, and 24 hours after disappearance of chlorine residual. If these samples indicate that the water is not potable, the chlorination procedure must be repeated.

11. After sterilization the use of water for drinking purposes should not be permitted until bacteriological tests show that the water meets standards for potability. It is not necessary to restrict the use of water for other purposes at any time during the chlorination procedure or thereafter.

A schematic diagram of the procedure outlined above for the sterilization of newly laid fresh water mains is clearly indicated in figure 2.

Throughout the procedure outlined above repeated mention was made of the determination of "chlorine residuals." The necessary apparatus and reagent has also been mentioned. A detailed discussion of the ortho-tolidine test for "free" chlorine is beyond the scope of this report. It may be pointed out, however, that as in any chemical test, there may be interfering substances among which may be listed iron, manganese and nitrites. Furthermore, in lime-treated or in alkaline waters the characteristic color reaction may not occur, but this difficulty can be overcome by using an ortho-tolidine solution of stronger acidity than that used for neutral or acid waters. The chlorine residual referred to is a quantitative measure of HOCl as indicated by the ortho-tolidine "flash" reaction. It is to be distinguished from mixtures of chlorine and chloramine- or chloramines alone as measured by the ortho-tolidine reading after 20 to 30 minutes. If it is desired to take samples for bacteriological study at a time when a free chlorine residual is present in the water, it is necessary to add 1 ml. of a 10 percent solution of sterile sodium bisulfite or sodium thiosulfate to the water-sampling bottle.

DISCUSSION

The maintenance of a safe and adequate water supply in a naval establishment ranks in importance with providing sufficient supplies of food or of ammunition. Pollution of a water supply can readily result in large numbers of casualties and constitutes a real threat to security. In industrial shore establishments production can be crippled if the water supply is of insufficient quantity or of insanitary quality. It is the duty of the medical officer to safeguard the potability of the water. At the present time, as far as the Navy is concerned, the principal problems of water sanitation are those arising out of the construction of new shore establishments and training centers and the enlargement of older stations. There is a possibility that additional problems may arise as a result of bombing attacks. Now, more than ever, the medical officer is being called upon for opinions and advice in the field of sanitation. Expansion of the New York Navy Yard was directly responsible for the investigations which form the basis of this report. The fact that it was necessary to maintain an active water supply during the period of main sterilization led to the development of the method described and incidentally to an apparent solution of a problem which has been troubling water works authorities for many years.

The procedure for sterilizing water mains outlined in this report has been applied to more than a dozen sections of piping varying in length up to 5,000 feet. The results have been uniform in all cases. When hemp braid has been used for calking, two or three 24-hour

applications of chlorine will sterilize the line. A limited number of observations where a substitute calking material has been employed indicates that one application of 24 hours or even less may be adequate. The fact that sterilization can be accomplished with a portable chlorination apparatus gives wide latitude to the application of this method.

The writers wish to express their gratitude to Dr. H. S. Mustard and Prof. E. B. Phelps of the DeLamar Institute of Public Health, Columbia University, for providing laboratory facilities during the course of this study.

Laboratory technical procedures were carried out principally by Pharmacist's Mates, second class, Ellis Katzman and Russell Olson.

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SUGGESTIONS TO THE NAVAL MEDICAL OFFICER FOR TALKS ON VENEREAL DISEASE¹

WITH A CATALOG AND DISCUSSION OF OTHER EDUCATIONAL MEDIA

FRANK W. REYNOLDS
Lieutenant (MC) U. S. N. R.

The naval medical officer is "charged with responsibility for the prevention and control of disease and promotion of health" among service personnel (1). To fulfill his responsibility he must face the fact that of all the preventable diseases which waste the manpower and burden the hospital facilities of the Army and Navy, the greatest problem is that of venereal disease (2).

Medical officers with special formal training and experience are assigned (3) to naval districts and important shore activities, to duty with the Marines, and to certain fleet and foreign units. As venereal disease control officers with a broad clinical background and knowledge of public health procedures (4) they are concerned with the development and coordination of the venereal disease control program in all of its aspects—diagnosis, treatment, prophylaxis, education, civilian relations. However, all medical officers are "charged with instructing the entire personnel regarding the nature of venereal diseases, and warning them of the dangers therefrom" (5).

¹ From the Division of Preventive Medicine, Bureau of Medicine and Surgery.

To some few, perhaps, venereal disease education is a chore, thrust upon them by regulations to which they must pay lip service. To others, more fully aware of the magnitude of the problem of venereal disease and of their own important part in the control of these diseases, every preventive measure is regarded as an opportunity for service, a means of keeping "as many men at as many guns as many days as possible."

PRINCIPAL MEDIA OF VENEREAL DISEASE EDUCATION

Sight should not be lost of the fact that the talks of the medical officer are but one of several educational devices available. Cognizant of the worth of visual methods in venereal disease education, both the Army and the Navy have prepared motion picture films depicting many of the salient "facts of life".¹ Productions at present available generally present a substantial amount of basic information which may in some cases obviate the necessity of a formal, informative talk and indicate, rather, a discussion-talk to clarify specific questions.

Pamphlets published by the Services themselves, by the United States Public Health Service, the American Social Hygiene Association, and by local health departments, have been used widely. These provide basic, frequently detailed, information in easily understood lay language, and are valuable for reference by enlisted personnel and as a supplement to films and talks. Leaflets stressing special points for specific groups, i. e., recruits, also are utilized.

Posters, the best of which often are prepared on the spot to meet local problems, also are valuable as a means of reiterating the salient points, as "reminders" of lessons learned. Sound-film strips are useful, especially for training purposes, and for describing the basic trends and elements of the venereal disease problem. Electrical transcriptions including the "dramatic" variety may be used over public address systems and for group meetings.

The fact remains, however, that a well-planned and well-delivered man-to-man discussion by a medical officer known to and respected by the men is an effective and rather basic method of disseminating the facts that "every young man should know." Discussions may take a variety of shapes—formal lectures, question-and-answer group discussions, informal talks centered around lantern slide or film strip material, personal interviews on request or for the purpose of obtaining exposure and contact information, teaching sessions with hospital corpsmen (6) on technics and policies.

Whatever the form of the discussion, it must ever be borne in mind that its content and the tack taken should be a "tailored fit" to the

¹ A catalog of venereal disease education materials appears at the end of this article.

specific group addressed. Data of a technical, medical character are not only lost on the bulk of enlisted personnel, but may mitigate against understanding and retention of the essential facts. Further, to quote Commander T. J. Carter, (MC), USN:

We must recognize clearly that if we are to be successful in either the prevention or alleviation of venereal disease, we must enlist the wholehearted support and understanding—emotionally as well as intellectually—of the persons with whom we deal.

MAJOR FACTORS IN THE EDUCATIONAL TALK

In the thoroughly masculine atmosphere of the barracks and the man-of-war, the subjects of sex, warfare, and religion dominate conversation. Not the least of these is sex. The subject of venereal infections, so intimately related to the sexual act, thus is not one to which virile young men are indifferent.

It is the exceptional man who, by the time he is old enough to carry arms, has not been exposed to considerable information pertaining to sex. His facts *may* be accurate; they may have been gained through formal instruction or from enlightened parental sources. More likely his "facts" and opinions are unscientific and biased, and of a scuttlebutt character. A significant proportion of men, by the time they reach the military services, have their ideas about sex and their sexual habits well crystallized.

An oft-repeated estimate is that from 10 to 15 percent of men, restrained by a sense of moral, religious, or esthetic values, will not risk illicit sexual intercourse at all. Another group of comparable size, made up of the constitutionally inferior and of those with inadequate or improper early training, will expose themselves at every opportunity. Between the two extremes is the majority of men, perhaps 70 to 80 percent of the total, ordinarily continent and satisfied with wholesome recreation, who nevertheless may take chances under certain predisposing circumstances. It is toward the last group that educational measures may be directed with the expectation of tangible results. In the application of educational measures, however, Commander Carter has pointed out that:

It does not do, for instance, to assume that because a man or woman is in the armed service that we can by fiat create new habits. It must be kept in the foreground of our thinking that at the crucial moment when a decision must be made by the individual relative to exposure or not, prophylaxis or not—and so on—he is *not* under the direct disciplinary influence of the military organization. What counts then is not only what we have taught him, but *how* we have taught him. A failure in teaching reacts not so much on the man as it does on the medical record and objectives of the program as a whole (7).

THE PURPOSE OF THE TALK

The medical officer should seek to leave with each of his individual listeners some thought which will flash before their minds at critical

moments, some rejoinder which effectively will deter them from exposing themselves to venereal infection or which forcibly will suggest to them the urgency of prophylaxis.

The appeal.—To what in a man's intellectual or emotional make-up can one appeal? It is generally agreed that the moral issue should not be stressed by the medical officer. Not that naval medical officers are disinterested in clean living. They are definitely interested, but the Chaplain Corps has been charged with the prime responsibility for the maintenance of high moral standards. The medical officer's energy is most effectively employed when centered upon the medical aspects of venereal disease control. The medical officer and the chaplain have clearly circumscribed responsibilities. Each must respect the other's sphere of activity and not attempt to encroach upon it.

It is the task of the medical officer in his talks to bring the facts to bear on his audience in a manner best calculated to produce the desired objective. Good and sufficient reasons must be evident to each individual addressed if any substantial effect is to be obtained. The "soft spot" in a man's armor may be found by appeal to:

(1) *Pride.*—Every man has an innate sense of self respect. That which may debase him in the eyes of others strikes at his pride. The service man's pride in his organization is a special emotion to which an appeal may be made. Just as the college man will "die for dear old Rutgers," so will the service man hesitate to do anything which may adversely affect his ship or his outfit. Among Negro groups, the feeling of racial pride is one which medical officers may utilize effectively.

(2) *Patriotism.*—Because of the magnitude of the venereal disease problem in the Navy, the bluejacket whose training or service is interrupted by preventable disease fails to live up to his responsibility toward the country he serves. Because of ignorance or carelessness, he retards the war effort. And in the words of the Secretary of the Navy:

"We need the full time of every man in the armed services, in order to achieve victory at the earliest possible date * * *. Today you are challenged by the enemy—you must protect yourself so that you can beat the enemy, safeguard your loved ones, your country, and preserve our whole way of life. This can be done only through your own efforts to keep physically fit; and physical fitness comes through self-discipline and determination * * *. The person who fails to heed the advice here given is betraying the trust that his country has placed in him in its hour of need" (8).

(3) *Home and family.*—What man knowingly would place in jeopardy his wife or wife-to-be? What man would chance sterility from gonorrheal epididymitis or the possibility of congenitally syphilitic offspring if he thoroughly understood the facts?

Needless to say, almost any so-called appeal will lose its effect if too obviously put, or overemphasized. The foregoing, therefore, may have some considerable limitations. Of more real effect may be appeals to:

(4) *Reasonableness.*—Because of the dangers of venereal disease, indiscriminate sexual exposure without protection is asinine. The man who, knowing the possible consequences, persists in being sexually promiscuous, is unreasonable.

able and foolish. The old adage, "One night with Venus may mean two years with Mercury," is in point. No man considers himself simple or foolish, and an appeal to his sense of proportion should not fall on barren ground.

A valuable analogy is the parable of "the good soldier." Of two soldiers on reconnaissance duty, one is well trained and able to take cover when exposed to danger; the other, because he has not learned to protect himself, may compromise his own safety and the success of his mission. It is smart to be a good soldier, and it is likewise smart to learn precautionary measures against another danger, venereal infection.

(5) *Fear*.—He who speaks on venereal disease is admonished by some to avoid the "scare" approach. The dangers of syphilophobia and of needless worry over infection are real, and to be avoided. It is impossible, however, to disregard the fact that fear of infection and fear of the consequences of infection may serve to make prostitutes and casual pick-ups undesirable, or prophylaxis attractive when nothing else will succeed.

One must differentiate fear of infection from fear of punishment. Punitive measures rarely dissuade a man from sexual exposure. On the contrary they contribute to concealment of infection and self-treatment. Fear of disease on the other hand not only tends to promote prophylaxis but also impresses upon the man the need for prompt and adequate therapy if he becomes infected.

Publicity of the "one-day cure" for syphilis and of the effectiveness of sulfonamide drugs in gonorrhea has revived the comparison of these diseases to a "good hard cold." The fact is that syphilis and gonorrhea are dangerous diseases that require expert medical care.

The possible consequences of venereal infections should not be passed over lightly. Serious situations deserve serious consideration. However, the grim prospects should be tempered with emphasis upon the effectiveness of modern therapy. The fear motive cannot be disregarded; the facts themselves are fearsome.

THE MANNER OF PRESENTATION

Experience has shown that when talks on venereal disease are not well received, the fault seldom lies with the subject itself, but with the manner in which it is presented. An understanding of the problem, a knowledge of men, and an enthusiasm and interest which in some measure can be transmitted to the audience are highly desirable.

The medical officer should speak informally but with dignity. Something of a "big brother" attitude, conveying the impression that the speaker is anxious to help his listeners, and promote the best interests of the service, is effective. Technical terms and polysyllabic words should be avoided. Consider the plight of the medical officer who, having finished a talk to a group of enlisted men, was asked where one could obtain a "box of continence," and how much it cost! The men's "own language" is to be used, but without being unduly familiar or condescending. Vulgarity or far-fetched humor is to be avoided.

Few speakers can hold the interest of their audience longer than 10 to 15 minutes. Prolongation of the talk beyond this can but detract from it.

Remember also that the men may have had to trudge a considerable distance, or to experience other inconveniences, to hear this talk. They must realize that what is to be said is something worth while. The speaker is obligated to make it so.

AN OUTLINE OF A SUGGESTED TALK

1. *The introduction.*—Many medical officers have found the "Why I'm here," or the "Why the Medical Corps and the Navy as a whole are concerned," type of prefatory remarks useful. First, therefore, probably should be a brief but lucid statement of the effect of venereal disease infection on the Navy, i. e.:

(a) Admission rates and noneffective ratios show a declining trend. The admission rate per 1,000 per annum for 1942 for the entire Navy was 37; for the corresponding 1941 period, 51. The continental United States rate for 1942 was 26; for 1941, 31. The 1940 noneffective ratio was 1 to 3; 1941, 1 to 1.5; 1942 (estimated) 1 to 0.73.

(b) BUT—the admission rate means that 37 out of every 1,000 men in the Navy in 1942 were at some time on the sick list for venereal disease. The noneffective ratio means that *every day* more than 7 men out of every 10,000 are on the sick list because of venereal disease.

(c) It is estimated (on the basis of the first 6 months of 1942) that on an average each case of syphilis involves 11 sick days; each case of gonorrhea and of chancroid, 5 days each. Venereal disease stands second to all causes of sickness in the Navy.

These statistics really mean, however, that the Navy suffers from the resulting breakdown of teamwork and the inefficiency; that medical material and personnel must be expended; that the man himself is physically, perhaps mentally, damaged and suffers losses in time, pay, and advancement opportunities.

2. *Description of the diseases.*—A brief discussion of the symptoms and signs of syphilis and gonorrhea in the male and in the female may come next. Detailed clinical descriptions are to be avoided. It is necessary only that men know what symptoms should lead them to suspect infection. The apparent insignificance of early lesions should be stressed. There is reason to discuss only syphilis and gonorrhea. Chancroid, lymphogranuloma venereum, and granuloma inguinale may be mentioned, but only in passing. Familiar nonmedical synonyms for anatomic parts assist in this discussion: e.g., male organ for penis; groin for inguinal area; foreskin for prepuce; clap for gonorrhea; sac for scrotum, etc.

Table 1.—Common misconceptions about venereal disease.²

That syphilis is incurable.

That syphilis is cured when the primary lesion disappears.

That syphilis, in all stages of the disease, is infectious.

² Modified from Regenburg and Durfee (9) and Youngkin (10).

That gonorrhea is no worse than a "bad cold."

That gonorrhea is cured when the urethral discharge stops.

That gonorrhea, if neglected, may turn into syphilis.

That it is possible to acquire gonorrhea from excessive copulation ("a strain").

That gonorrhea may be caused by having intercourse with a menstruating woman.

That venereal disease can be contracted easily from a toilet seat or towel.

That it is possible to contract a venereal disease from masturbation.

That all children born to individuals who have a venereal disease will be subnormal.

That it is better to take prophylaxis 2 hours after intercourse than immediately thereafter.

That prophylaxis is painful or harmful.

3. *Explode common misbeliefs.*—A fact which medical officers may forget is that men harbor many misconceptions about the venereal diseases. How extensive these misconceptions may be has been pointed out by Regenburg and Durfee (9) and by Youngkin (10). In table 1 are listed the more common of these items of misinformation.

4. *How and from whom venereal diseases are acquired and spread.*—Venereal diseases are acquired by sexual intercourse with infected women. The number of infections innocently acquired is extremely small, so small that they may be dismissed without comment.

What women may be infected? (a) *Prostitutes* of course, for it is practically impossible for a prostitute to remain free from syphilis and gonorrhea. They may be "professionals," but there is no reliable way for them to "take care of themselves," as some would have us believe. (b) *Promiscuous women*: The majority of free pickups also are diseased. Their sexual promiscuity eventually results in infection. (c) *Friends*: A difficult lesson to learn is that if one's girl-friend permits intercourse, she may allow others the same liberty, and thus expose herself to infection.

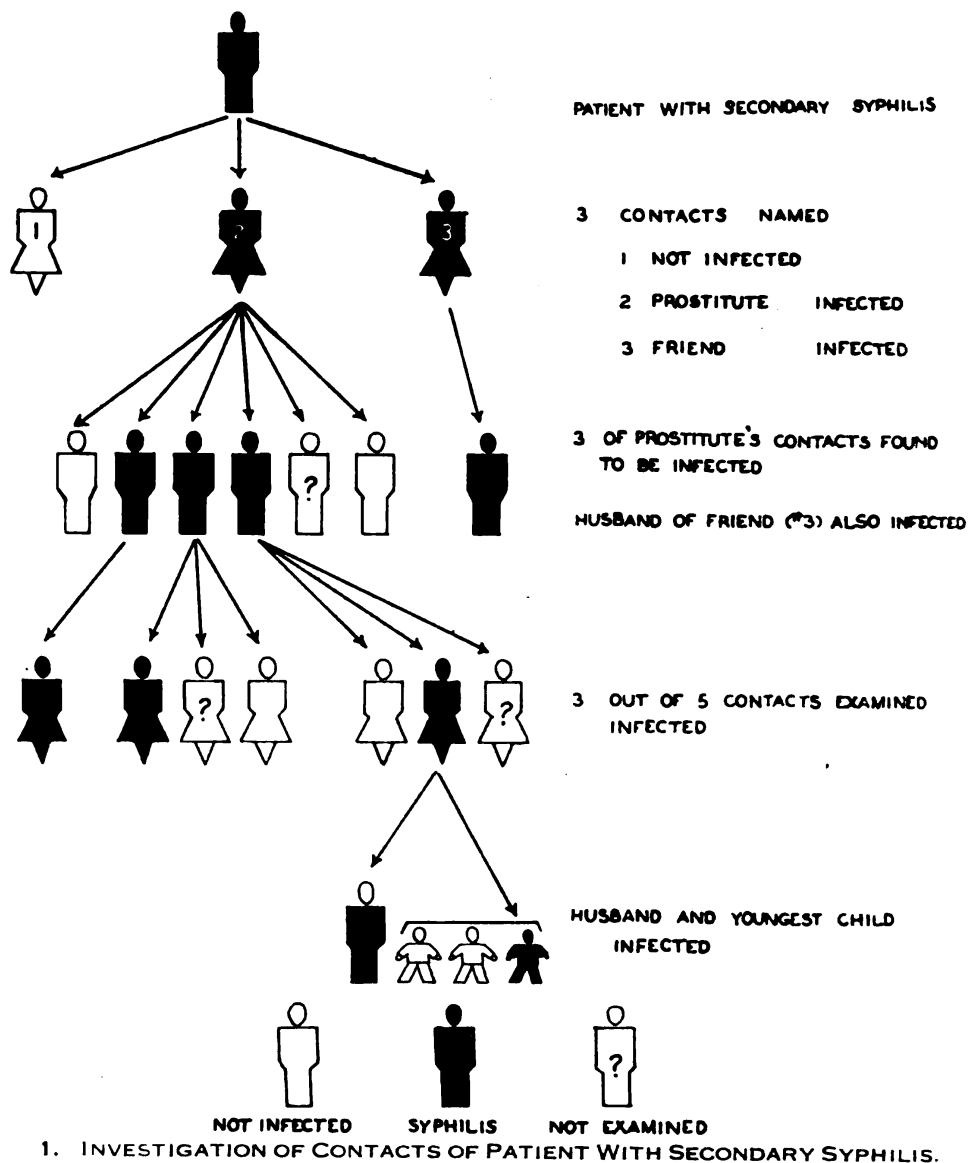
Anyone with a knowledge of the anatomy of the female genitalia knows that it is impossible even for a trained physician to tell whether a woman is free from venereal disease. How then, can the layman know that a girl is "safe"? For the same reason, so-called health certificates are worthless.

"*The "Who, me?" attitude.*—Much wishful thinking permeates the attitude of men in their relations with the opposite sex. *He* can pick clean girls. Others may have syphilis or gonorrhea, but *he* knows *his* girl is all right. This attitude, all too frequent among service men, results in failure to take prophylaxis, and is responsible for many infections.

Closely allied to the "Who, me?" attitude is the feeling that "It can't happen to me." Not infrequently there is much surprise on the part of the men who find themselves in the venereal disease ward.

They had to learn the hard way that "you can't tell by looking," and that, "it *can* happen here" if precautions are not taken.

If available, data as to the prevalence of venereal disease among civilians in contiguous communities should be utilized. It is worth mentioning that syphilis and gonorrhea spread as multiple small epidemics. This fact may be presented by means of a simple chart (fig. 1).



A discussion of the relationship between alcohol and sex may be best avoided, or at most only mentioned in passing. Under the influence of alcohol men may take chances they would not think of taking otherwise. Moderation is the key word, for even water in excess may be harmful. Aristotle's phrase, "In nothing too much," expresses the idea succinctly. The important point is that a man may neglect to use prophylaxis when he is inebriated.

5. *How venereal infections can be prevented.*—Syphilis and gonorrhea can be avoided if men remember the “Four C’s”—Continence, Condom, Cleansing, and Chemical Prophylaxis.

Continence, the one sure preventive, is not only possible, but entirely feasible. A common misconception is that sexual relations are necessary if a man is to remain healthy and virile. This idea is without basis in physiologic fact. Indeed, overindulgence may have an exhausting effect, as athletes in training know.

The condom is the most effective single prophylactic device, *if it is used properly*. To be effective, the condom must be without defect; must be applied correctly and before indulgence in preliminary sex play; and removed carefully by turning inside out.

After intercourse, cleansing and chemical prophylaxis should be used as soon as practicable. The time element should be stressed, for the effectiveness of these measures diminishes rapidly with the passage of time.

If a list of prophylactic station locations has not been provided or posted, men should be informed of them. Men should be told that shore patrol and military police can direct them.

6. *What to do if infected.*—If a man suspects that he may have a venereal disease, he should report at once to the medical officer for examination and treatment. Modern therapy for syphilis and gonorrhea is effective if instituted early by a competent physician.

Self-treatment and treatment by druggists and quacks unfortunately is not uncommon. The men should realize that the sulfonamides used in the treatment of gonorrhea and the arsenical treatment of syphilis are potentially dangerous, and should be controlled rigidly by a medical officer.

If any medical officer doubts that self-treatment is common, he should consider the experience of one of his colleagues in an Army camp. Impressed by a large percentage of sulfonamide failures, this physician decided to test the urine of each “new” patient for the presence of sulfonamides. Over two-thirds of the individuals were found to have taken sulfonamides before reporting to the medical officer!

7. *Summary.*—In closing, the most salient facts of the talk should be summarized. Finally, an opportunity for questions should be provided. Some medical officers have accomplices in the audience to ask the first questions, finding this an effective method of stimulating further interest. Having answered all questions, the medical officer may invite men with questions they prefer not to raise before the group to come to the sick bay for an informal and confidential chat.

ADAPTATION OF THE TALK TO THE AUDIENCE

One must keep in mind the fact that talks about venereal disease must be adapted to the audience. In general, the facts are similar,



FIGHT...

syphilis and gonorrhea

Avoid exposure

Avoid pickups and prostitutes

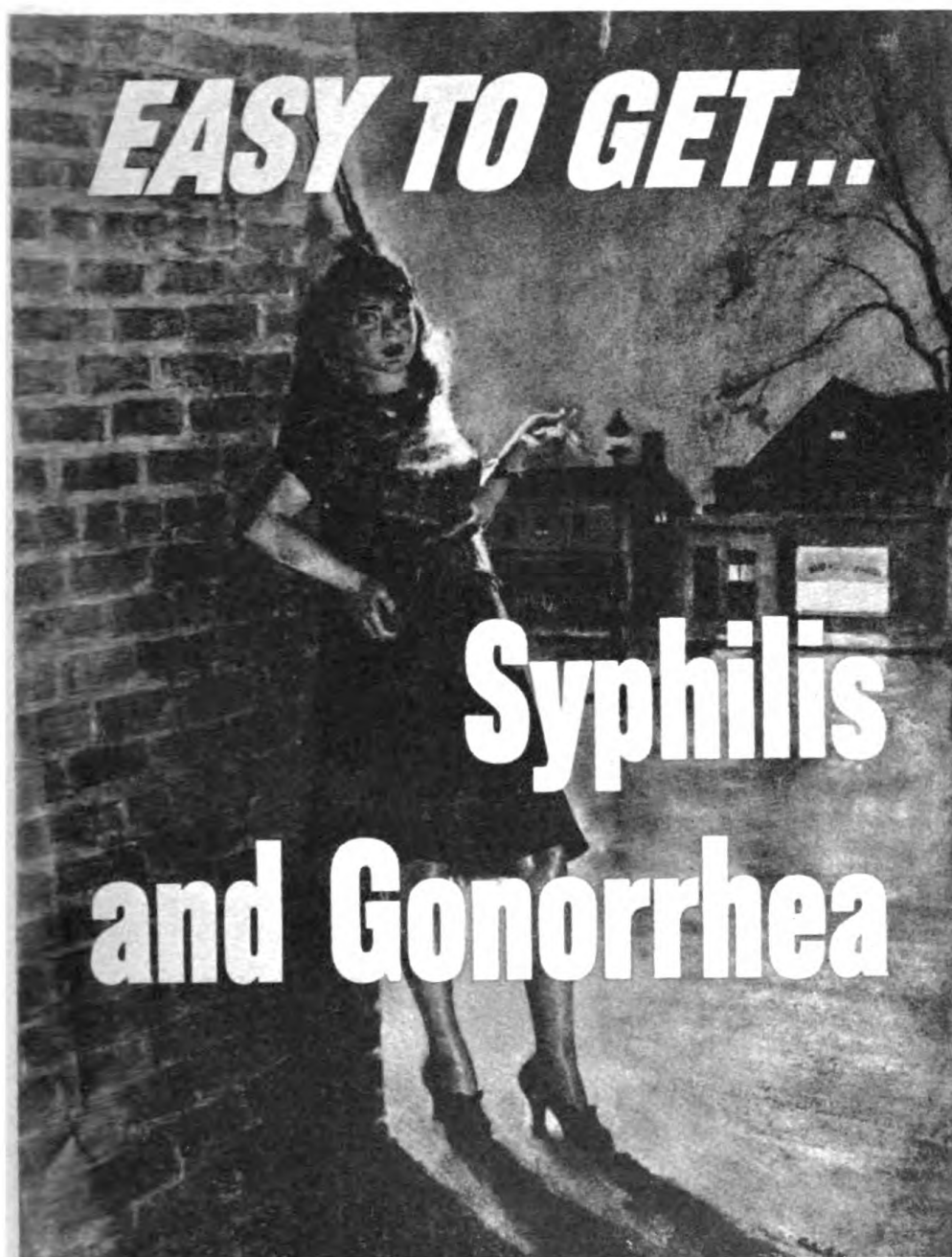
If exposed, use prophylaxis

If infected, see a medical officer

2. VENEREAL DISEASE POSTER (VP-1) ISSUED BY THE U. S. NAVY IN CONJUNCTION WITH THE OFFICE OF WAR INFORMATION.

but the manner of presentation should be varied to suit the intelligence and the previous training of those listening. Variations are also necessary when the talk precedes or follows one of the training films on venereal disease prevention.

While the majority of talks will be given to enlisted personnel, it is well to consider that commissioned and noncommissioned offi-



3. VENEREAL DISEASE POSTER (VP-2) ISSUED BY THE U. S. NAVY IN CONJUNCTION WITH THE OFFICE OF WAR INFORMATION.

cers and officer candidates need the same sort of information. Indeed by concentrating on these latter groups, urging them to assist in the education of the men in their own command, the facts about venereal disease effectively may filter down to the enlisted man.

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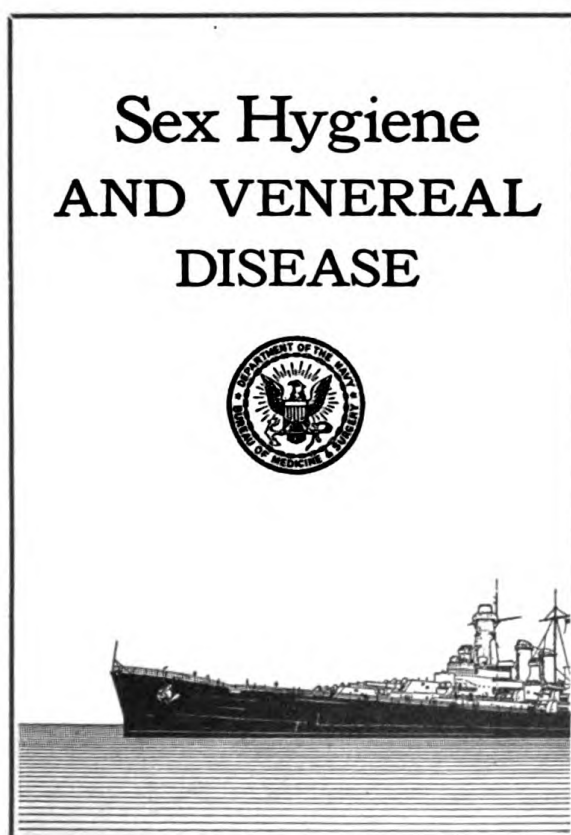
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**ANNOTATED CATALOG OF VENEREAL DISEASE EDUCATION
MATERIALS, U. S. NAVY³**

MOTION PICTURES

Sex Hygiene.—A lecture-type Navy film describing how venereal diseases are contracted, the parts of the male anatomy affected, and the relative incidence of



3. NAVY PAMPHLET ON SEX HYGIENE AND VENEREAL DISEASE.

the various diseases. Symptoms of the diseases and prophylactic procedures are demonstrated. Stress is placed upon prompt prophylaxis after exposure. *Sound, 20 minutes, 16 and 35 mm., No. MN-38.*⁴

³ Prepared by the Section of Venereal Disease Control, Division of Preventive Medicine, Bureau of Medicine and Surgery.

⁴ Films are available at most activities or may be obtained by directing an official request in triplicate, to the Chief of the Bureau of Aeronautics, noting the number and title of the film. Reference should be made to "Catalog of United States Navy Training Films—November 1942," available from the educational officer of activities or from the Bureau of Aeronautics, Training Film Unit, Photographic Section.

Sex Hygiene.—A lecture-type Army film similar in content to Navy film of same title. *Sound, 26 minutes, 16 and 35 mm., No. MA-421.*⁴

Know for Sure.—A U. S. Public Health Service dramatic-type film for men (especially industrial workers) on nature, cause, and prevention of syphilis. Emphasis on importance of prompt attention to early syphilis and value of condom in prevention. *Sound, 20 minutes, 16 and 35 mm., No. MG-937.*⁴

Health Is a Victory.—An American Social Hygiene Association lecture-type film of the story of the fight against gonorrhea. Describes the appearance of gonorrhea germs, the incidence of the disease, symptoms, methods of treatment, how gonorrhea spreads, and how it is controlled. *Sound, 12 minutes, 16 and 35 mm., No. MC-1001.*⁴

Fight Syphilis.—A U. S. Public Health Service dramatic-narrative-type film of the fight against syphilis and gonorrhea. Shows the result of untreated venereal disease to individuals and nation; defines dangers of prostitution and

TO
A YOUNG MAN
ENTERING THE
NAVY



READ THIS
NOW

4. NAVY LEAFLET "TO A YOUNG MAN ENTERING THE NAVY"

self-treatment; outlines the elements of an effective venereal disease control effort. *Sound, 12 minutes, 16 and 35 mm., (number to be assigned).*⁴

PAMPHLETS

Sex Hygiene and Venereal Diseases.—A Navy pamphlet outlining in simple language the basic facts of sex and venereal disease. Information on symptoms, course, importance of professional treatment of syphilis, gonorrhea, and other venereal diseases. Discussion and instructions for individual and station prophylaxis. Directed to "all Navy personnel." (Fig. 3.) (Available from the Naval Medical Supply Depot, Brooklyn, N. Y.)

To a Young Man Entering the Navy.—A Navy leaflet emphasizing the danger of sexual promiscuity, importance and technic of prophylaxis, and loss to the Navy by preventable venereal disease. Specifically designed for new members of the Naval Service. (Fig. 4.) (Available from the Naval Medical Supply Depot, Brooklyn, N. Y.)

POSTERS

Fight Syphilis and Gonorrhea.—A Navy poster pointing up the necessity to (1) avoid exposure; (2) avoid prostitutes and pick-ups; (3) if exposed, use prophylaxis; (4) if infected, see a medical officer. For general use. (Fig. 2.) *In color, size 14 by 22 inches on heavy paper, No. VP-1.*⁵

Easy to Get—Syphilis and Gonorrhea.—A Navy poster emphasizing the venereal disease danger of "pick-ups" and promiscuous exposures. For general use. *In color, size 14 by 22 inches, on heavy paper, No. VP-2.*⁵

OTHER SOURCES OF MATERIALS

Motion pictures, pamphlets, posters, electrical transcriptions, and other materials not specifically prepared for Navy use but adapted in some degree may be obtained from:

United States Public Health Service,
Division of Venereal Diseases,
Washington, D. C. (Bethesda Station)

American Social Hygiene Association
1790 Broadway, New York, N. Y.

State, city, and county health departments.

EQUIPMENT

Motion picture and film-strip projection equipment is available at most activities. If not, request should be made through official channels to the Chief of the Bureau of Ships. Available are: 16-mm. sound-silent projectors, screens, and supplementary equipment; film-strip projectors, with 33 and 72 r. p. m. turntable.

⁵ Navy posters may be obtained by official request to the Chief of the Bureau of Medicine and Surgery. Reference should be made to the catalog, and the title and number of the poster stated.

STATISTICS

HEALTH OF THE NAVY

The statistics (annual rates per 1,000) appearing in this summary were compiled from data contained in monthly reports of communicable diseases received in the Bureau for the months of October, November, and December, 1942:

ENTIRE NAVY

Year	All diseases	Injuries and poisonings	All causes	Communicable diseases		Venereal diseases
				A	B	
1937	472	39	511	11	118	93
1938	325	57	382	4	76	81
1939	363	54	417	3	84	98
1940	511	49	560	35	223	81
1941	332	59	391	13	100	45
1942	412	49	461	24	187	31

FORCES ASHORE

1937	535	49	583	11	169	55
1938	330	55	386	7	104	40
1939	368	54	422	4	117	52
1940	487	49	536	27	229	52
1941	366	58	424	18	126	30
1942	466	45	510	30	227	25

FORCES AFLOAT

1937	398	34	469	10	89	116
1938	321	59	380	2	59	103
1939	360	54	414	3	64	126
1940	533	48	581	43	219	106
1941	294	60	354	7	72	62
1942	279	59	338	9	86	45

Food poisoning.—Special reports of food poisoning during October, November, and December 1942 were received from 11 shore stations and 1 ship. The causes of the outbreaks were listed as ham in 5 instances, chicken salad in 2, and chicken a la king in 1. The causes of 4 outbreaks were undetermined.

DISEASES CAUSING SURVEY

The following table was prepared from reports of medical surveys received in the Bureau during October, November, and December 1942 in which disabilities or disease causing the survey were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office:

Cause of survey	Num-ber of surveys	Cause of survey	Num-ber of surveys
Abscess, Brodie's	1	Blepharitis	8
Abscess, chronic, left jaw	1	Bromidrosis	3
Abscess, periapical	1	Bronchiectasis	36
Absence acquired, teeth	224	Bronchitis, chronic	10
Absence, congenital, ear	1	Bursitis, chronic	8
Absence, congenital, lumbar vertebra	1	Calcification, lung	1
Absence, congenital, soft palate	1	Calculus, kidney	3
Accessory rib	1	Calculus, common bile duct	1
Acne, cystic, face	2	Calculus, renal	5
Acne necrotica, scalp	1	Calculus, ureter	2
Acne vulgaris	11	Calculus, urethral	1
Acromegalia	3	Callosity	1
Adhesions, abdominal	2	Carcinoma	3
Adhesions, intestinal	2	Cardiac arrhythmia, auricular fibrillation	4
Albuminuria	22	Cardiac arrhythmia, paroxysmal tachycardia	7
Alcoholism, chronic	49	Cardiac arrhythmia, premature contractions	3
Allergy	15	Cardiac disorder, functional	7
Amblyopia	141	Cardiospasm	1
Amputation, traumatic	2	Caries, teeth	20
Anaphylaxis, egg protein	1	Cataract	12
Anemia	3	Cataract, congenital	1
Aneurysm	3	Cerebrospinal syphilis, undifferentiated	4
Angina pectoris	6	Cholecystitis, chronic	6
Angioneurotic edema	2	Cholelithiasis	7
Ankylosis	10	Chilblain	1
Anomaly, congenital, diaphragm	1	Chondroma, finger	1
Aortitis	2	Chorea	3
Aphakia	4	Chorioretinitis	19
Arteriosclerosis, general	17	Choroiditis	10
Arteriosclerosis, local	1	Cicatrix, skin	7
Arthritis, acute	2	Cirrhosis, liver, atrophic	5
Arthritis, chronic	156	Colitis, chronic	1
Arthritis deformans	1	Colitis, ulcerative	4
Asthma	251	Color blindness	3
Astigmatism, compound, hyperopic	7	Compression, brain	1
Astigmatism, compound, myopic	43	Compression, ninth thoracic vertebra	1
Astigmatism, simple, hyperopic	1	Conjunctivitis	1
Astigmatism, simple, mixed	6	Constipation	1
Astigmatism, simple, myopic	2	Constitutional psychopathic inferiority with psychosis	1
Atrophy, arm and hand	1	Constitutional psychopathic inferiority without psychosis	97
Atrophy, foot	1	Constitutional psychopathic state, emotional instability	282
Atrophy, leg	6	Constitutional psychopathic state, inadequate personality	257
Atrophy, muscle	6		
Atrophy, nerve, optic	2		
Atrophy, testicles	1		
Avulsion, ligament, knee	1		

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Constitutional psychopathic state, paranoid personality	15	Epiphora	1
Constitutional psychopathic state, pathological liar	3	Epiphysitis, left femur	2
Constitutional psychopathic state, schizoid personality	1	Epiphysitis, vertebral	4
Constitutional psychopathic state, sexual psychopathy	11	Erythromelalgia	2
Contracture	8	Eventration of diaphragm	1
Convulsive seizures	2	Familial pigmentary degeneration of retina	1
Coronary heart disease, arteriosclerotic	12	Fibroadenoma, male, breast	1
Coronary thrombosis	1	Fibrosis, pulmonary, interstitial	3
Coxa vara	4	Flat foot	372
Cryptorchidism	49	Foreign body, traumatic	3
Curvature, spine	21	Foreign body, nontraumatic	2
Cyst, benign	1	Fracture, compound	1
Cyst, dentigerous	1	Fracture, simple	16
Cyst, retention	1	Fungus infection, skin	2
Cyst, multilocular, lungs	1	Ganglion, semimembranous	1
Cyst, teratoma, inflamed	21	Gastritis, chronic	37
Cyst, thyroglossal duct	1	Gastroduodenitis	8
Dacryocystitis	1	Genu recurvatum	2
Deafness, bilateral	58	Genu valgum	1
Deafness, unilateral	35	Gigantism	1
Deafness due to heavy firing	1	Gingivitis, chronic	1
Defective vision	2	Glaucoma	2
Deformity, acquired	183	Glycosuria	3
Deformity, congenital	115	Goiter, exophthalmic	2
Dermatitis	13	Gonococcus infection, epididymis	1
Dementia paralytica	3	Gonococcus infection, joint	1
Dementia praecox	155	Gonococcus infection, prostate	5
Detachment, retina	4	Gonococcus infection, seminal vesicles	1
Deviation, nasal septum	3	Gonococcus infection, urethra	4
Diabetes mellitus	54	Gout, chronic	1
Diabetes insipidus	1	Hallux valgus	6
Dislocation, articular cartilage	38	Hammertoe	11
Dislocation, chronic recurrent	30	Hay fever	4
Dislocation, crystalline lens	1	Headache	30
Dislocation, joint	12	Heart disease, congenital	13
Diverticulum, duodenum	1	Hemangioma	4
Diverticulum, intestinal	1	Hematemesis	2
Duodenitis	20	Hematoma	2
Dyspituitarism	2	Hematuria	2
Dystrophy, progressive	3	Hemiplegia, old	1
Eczema	21	Hemoptysis	1
Effort syndrome	16	Hemophilia	1
Emphysema, pulmonary	2	Hemorrhoids	4
Encephalitis, chronic	5	Hepatitis, chronic	1
Encephalopathy, traumatic	2	Hernia, diaphragmatic	2
Endocarditis, chronic	2	Hernia, inguinal, direct	5
Endocrinopathy, Fröhlich's syndrome	1	Hernia, inguinal, indirect	91
Endocrinopathy, hypogonadism	1	Hernia, muscle	1
Endocrinopathy, hypopituitary	1	Hernia, nucleus pulposus	1
Enlargement, prostate	4	Hernia, recurrent after operation	31
Enteritis, chronic	1	Hernia, traumatic	4
Enuresis	105	Hernia, umbilical	3
Epidermolysis bullosa	1	Hernia, ventral	6
Epididymitis, acute	1	Hiccough	1
Epilepsy	229	Hodgkin's disease	3
Epilepsy, Jacksonian	9	Hydro-aestivale	1
		Hydrocele, tunica vaginalis	2
		Hydronephrosis	7

Cause of survey	Num-ber of surveys	Cause of survey	Num-ber of surveys
Hyperchlorhydria	2	Neuritis, posterior tibial	1
Hyperopia	2	Neuritis, sciatic	20
Hypertension, arterial	139	Neuroretinitis	1
Hypertensive heart disease	13	Neurosis, gastric	16
Hypertrophy	4	Neurosis, intestinal	35
Hypobaropathy	1	Neurosyphilis, serological	6
Hypochondriasis	4	Night-blindness	2
Hypopituitarism	2	Nystagmus	2
Hypotension, arterial	1	Obstruction, intestinal	2
Hypothyroidism	6	Opacity, cornea	4
Ichthyosis	6	Orchitis, chronic	2
Ileitis	2	Organic brain disease	1
Inflammation, salivary gland	1	Osgood-Schlatter disease	13
Incontinence, urine	4	Osteitis fibrosa cystica	3
Injuries, multiple, old lacera- tion	1	Osteo-arthritis	1
Insufficiency, ocular muscle	3	Osteoarthropathy, hypertroph- ic	5
Intraspinal injury	3	Osteochondritis deformans	7
Intracranial injury, old	33	Osteochondritis dissecans	19
Irritable colon	7	Osteochondroma	8
Jaundice, hemolytic	2	Osteochondromatosis	1
Joint, internal derangement of	89	Osteomalacia	1
Keratitis	1	Osteoma	4
Kerato-conjunctivitis	1	Osteomyelitis, chronic	18
Keratoconus	1	Otitis media, chronic	229
Labyrinthitis	1	Otosclerosis	7
Laryngitis, chronic	1	Ozena	2
Leukemia, chronic	1	Pansinusitis	14
Leukoplakia	1	Paradentosis	32
Lipoma, multiple	1	Paralysis agitans	9
Loose body in joint	8	Paralysis, diaphragm	1
Loss of substance of bone	10	Paralysis, external recti muscle	1
Lupus erythematosus	1	Paralysis, ischemic, right per- oneal	1
Lymphadenitis, general	1	Paralysis, nerve	2
Lymphangitis, chronic	1	Paralysis, ocular muscle	4
Lymphogranuloma venereum	1	Paralysis, ulna	1
Lymphoma, generalized	1	Paralysis, vocal cord	1
Lymphoma, mediastinal	2	Pellegrini-Stieda disease	1
Lymphosarcoma	4	Perforated ear drum	4
Macular degeneration	1	Perforated nasal septum	7
Malaria	1	Periostitis, chronic	2
Malocclusion, teeth	2	Peripheral vascular disease	2
Mastoiditis, chronic	5	Pes cavus	21
Masturbation	2	Phimosis	2
Melanoma	2	Phlebitis	9
Ménière's disease	2	Pleurisy, fibrinous, chronic	37
Meningioma	1	Pleurisy, serofibrinous	4
Mental deficiency, moron	66	Pneumoconiosis	2
Metatarsalgia	17	Pneumonia, chronic, intersti- tial	1
Migraine	34	Pneumonitis, chronic, nontu- berculous	15
Myocarditis, chronic	64	Pneumothorax	6
Myopia	84	Poliomyelitis, anterior, chron- ic	4
Myositis, chronic	64	Polypus, nasal	3
Narcolepsy	8	Polypus, colon	1
Necrosis, left ulna and radius	1	Post-traumatic head syndrome	2
Nephritis, chronic	30	Post-traumatic personality dis- order	2
Nephroposis	5	Prolapse, rectum	6
Neuralgia	1		
Neuritis, brachial	1		
Neuritis, femoral cutaneous	1		
Neuritis, multiple	1		
Neuritis, intercostal	2		
Neuritis, optic	7		

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Prostatitis, chronic, nonvenereal	17	Stricture, urethra	8
Protruded intervertebral disc	1	Stricture, ureter	1
Pruritus ani	1	Sycosis	1
Psoriasis	11	Syncope	15
Psychoneurosis, anxiety neurosis	86	Synovitis, chronic	10
Psychoneurosis, compulsion neurosis	4	Synovitis, traumatic	1
Psychoneurosis, epileptic	1	Syphilis	85
Psychoneurosis, hysteria	69	Syphilis, sero-positive only	32
Psychoneurosis, neurasthenia	106	Tachycardia	17
Psychoneurosis, psychasthenia	11	Talipes	5
Psychoneurosis, situational	20	Telangiectasis	1
Psychoneurosis, traumatic	13	Tenosynovitis, chronic	6
Psychoneurosis, unclassified	66	Teratoma, metastatic, testicle	1
Psychosis, epileptic	3	Thrombo-angiitis obliterans	3
Psychosis, intoxication, alcoholic	1	Thrombosis	5
Psychosis, manic-depressive	56	Tic	1
Psychosis, traumatic	1	Trachoma	1
Psychosis, unclassified	8	Tuberculosis, pulmonary, acute pneumonic	3
Psychosis, with other disabilities (mental deficiency)	1	Tuberculosis, pulmonary, chronic, active, advanced	232
Psychosis, with psychopathic personality	3	Tuberculosis, pulmonary, chronic, arrested	510
Pterygium	1	Tuberculosis, pulmonary, primary, healed	110
Ptosis	3	Tumor, mediastinal	2
Purpura hemorrhagica	3	Tumor, mixed, benign	7
Pyelitis, chronic	2	Tumor, unclassified	1
Pyelonephritis	5	Ulcer, duodenum	312
Pylorospasm	1	Ulcer, gastric	2
Raynaud's disease	2	Ulcer, peptic	1
Recklinghausen's disease	2	Ulcer, skin	1
Retinitis	2	Ulcer, stomach	26
Rheumatic fever	17	Ulcer, stomach, perforated	1
Rheumatism, muscular	9	Ulcer, varicose, leg	1
Rhinitis, atrophic	12	Urethritis, chronic, nonvenereal	2
Rhinitis, hypertrophic	1	Undulant fever	2
Rhinoscleroma	1	Union of fracture, faulty	85
Rupture, traumatic	20	Urticaria	2
Rupture, nontraumatic	2	Uveitis	2
Salpingitis, eustachian, chronic	1	Valvular heart disease, aortic and mitral	35
Sarcoma	2	Valvular heart disease, aortic insufficiency	14
Schizoid personality	4	Valvular heart disease, mitral insufficiency	132
Seasickness	7	Valvular heart disease, aortic stenosis	4
Senility	1	Valvular heart disease, mitral stenosis	35
Sexual perversion	10	Valvular heart disease, pulmonary	3
Silicosis	7	Valvular heart disease, tricuspid	1
Simple adult maladjustment	4	Varicocele	1
Sinus, perineal	1	Varicose veins	31
Sinusitis, frontal	6	Vertigo	2
Sinusitis, maxillary	11	Wound, gunshot	3
Snoring	1	Wound, incised, scrotum	1
Somnambulism	26	Wound, lacerated	1
Spondylitis	17		
Spondylolisthesis	4		
Sprain	26		
Spur, bone	2		
Stammering	2		
Strabismus	20		
Strain	6		
Stricture, esophagus	1		
Stricture, rectum	1		
		Total	7,730

NOTES ON OUR RESERVE CONTRIBUTORS

Awe, Chester D., Lieutenant Commander (MC) USNR (*Meningococcic Meningitis in the San Diego Area During 1942; Recent Advances in Epidemiology and Treatment*, p. 625). B. S., University of Iowa; M. D., 1923. Intern, clinical assistant, and lecturer in medicine, University of Iowa, July 1923–July 1928. Private practice, El Paso, Texas, 1928–42; on the staffs of Southwestern General, Masonic, and City-County Hospitals. Member American Medical Association; Southwestern Medical Association; Texas Medical Association.

Benson, Clifton E., Lieutenant Commander (MC) USNR (*Treatment of Photophthalmia Following Exposure to the Rays of the Welding Arc*, p. 737). M. D., University of Minnesota, 1933. Resident, Head Specialties Dept., New York Post Graduate Hospital, 1934–36. Private practice (eye, ear, nose, and throat) Bremerton, Washington, 1937–41. Member American Board of Otolaryngology; American Board of Ophthalmology; American College of Surgeons; American Academy of Ophthalmology and Otolaryngology; Puget Sound Academy of Ophthalmology and Otolaryngology. Virginia Society of Ophthalmology and Otolaryngology; American Medical Association.

Bierman, Morris I., Lieutenant Commander (MC) USNR (*Aculsion Fracture of the Fibula*, p. 647). B. S., George Washington University; B. M., University of Minnesota, 1919; M. D., 1920. With Veterans' Administration, 1921–23; private practice, roentgenology, Washington, D. C., 1923–42. Member American Medical Association; District of Columbia Medical Society; Southern Medical Society; American Board of Radiology; Radiological Society of North America.

Bruce, Gordon M., Lieutenant Commander (MC) USNR (*Simple Methods for the Detection of Ocular Malingering*, p. 755). B. A., Dalhousie University, Halifax, Nova Scotia, 1925; M. D., 1925; Med. Sc. D., Columbia, 1934. Internship, Nova Scotia Tuberculosis Sanatorium, 1925; Royal Victoria Hospital, Montreal, 1925–26; Knapp Memorial Eye Hospital, N. Y., 1926–27. Private practice, New York, 1928–; attending surgeon, Eye Institute of Presbyterian Hospital, N. Y.; ophthalmologist, Vanderbilt Clinic, N. Y.; consultant ophthalmologist, Dover General Hospital, Dover, N. J., and Englewood Hospital, Englewood, N. J.; assistant clinical professor of ophthalmology, College of Physicians and Surgeons, Columbia University. New York State and County medical societies; American Academy of Ophthalmology and Otolaryngology; American College of Surgeons; American Ophthalmological Society; New York Ophthalmological Society; New York Academy of Medicine.

Carr, Robert M., Lieutenant (MC) USNR (*Toothache and the Aviator; a Study of Tooth Pain Provoked by Simulated High Altitude Runs in a Low Pressure Chamber*, p. 643). A. B., Kansas University, 1925; M. D., Northwestern University, 1934. Intern, Kansas City General Hospital, 1933–34; and Obstetrical Service, Maternity Center and Passavant Memorial Hospital, 1934–35. General practice, Junction City, Kansas, 1935–41. Member American Medical Association; Kansas Medical Society.

Craig, Winchell M., Captain (MC) USNR (*War Wounds of the Peripheral Nerves*, p. 613). A. M., Ohio Wesleyan University, 1915; Sc. D. (hon.) 1937;

M. D., Johns Hopkins, 1919; M. S. in Surgery, University of Minnesota, 1930. Professor of neurosurgery, Mayo Foundation; neurosurgeon, Mayo Clinic, St. Mary's Hospital, Kahler Hospital, Colonial Hospital, Rochester, Minn. Member American Medical Association; American Surgical Association; American College of Surgeons; Western Surgical Association; American Neurological Association; Society of Neurological Surgeons (Sec.-Treas.); Central Neuropsychiatric Association; Harvey Cushing Society; American Academy of Neurological Surgery (hon.); Central Society of Clinical Research.

Dorough, Warren S., Lieutenant Commander (MC) USNR (*A New Emergency Bed Litter*, p. 848). B. S., Emory University, 1921; M. D., 1923. Intern, Georgia Baptist Hospital, 1923-24; resident surgeon, 1924-25. Private practice, 1925-. Associate professor, surgery, Emory University; surgical staff member, St. Joseph's Infirmary and Emory University Hospital; surgical director of intern education, Georgia Baptist Hospital. Fulton County Medical Society; Georgia State Medical Association; Southern Medical Association; American Medical Association; Southern Society of Clinical Surgeons; Southeastern Surgical Congress.

Fetter, Ferdinand, Lieutenant Commander (MC) USNR (*Pneumonia; a Review of 588 Cases at the Philadelphia Naval Hospital*, p. 653). B. S., University of Minnesota, 1926; M. D., 1929. Resident, American Hospital of Paris, 1931; assistant physician, Philadelphia General Hospital, 1932-; assistant physician, Pennsylvania Hospital, Philadelphia, 1937-; assistant physician, Presbyterian Hospital, Philadelphia, 1933-1937; associate physician, Presbyterian Hospital, Philadelphia, 1937-; assistant instructor in medicine, University of Pennsylvania School of Medicine, 1933-1935; instructor, 1935-1941; associate, 1941-. Member, American College of Physicians; American Federation for Clinical Research; American Medical Association; Philadelphia College of Physicians. Certified, American Board of Internal Medicine. Contributor, *Duncan's Diseases of Metabolism*.

Fulcher, Oscar H., Commander (MC) USNR (*Tissue Reactions to Metallic Implants*, p. 845). B. S., William and Mary College, 1922; M. D., University of Virginia, 1926; M. S., surgery, Mayo Clinic, 1931. Internship, University of Virginia Hospital, Mason Hospital, Seattle. Fellow Mayo Foundation, 1928-33; fellow American College of Surgeons, 1934. Associate professor, clinical surgery, Georgetown University, 1937-.

Goldwater, Leonard J., Lieutenant Commander (MC) USNR (*The Sterilization of Water Mains*, p. 879). A. B., University of Michigan, 1924; M. D., New York University, 1928; Med. Sc. D., New York University, 1937; M. S. in Public Health, Columbia, 1941. Intern and resident in medicine, Bellevue Hospital, New York City, 1929-32. Instructor, medicine, New York University College of Medicine, 1932-36; instructor and assistant professor, preventive medicine, 1938-41. New York State Medical Society; American Public Health Association; New York Academy of Medicine; American Industrial Hygiene Association.

Goodale, Raymond H., Commander (MC) USNR (*The Use of the Cholera Principle in the Treatment of Tuberculosis*, p. 708). B. S., Wesleyan University, 1920; M. D., Harvard University Medical School, 1924. Adjunct professor of pathology, American University, Beirut, Syria, 1928-29; associate pathologist, City Hospital, Worcester, Mass., 1929-31; pathologist since 1931; assistant professor experimental pathology, Boston University School of Medicine, 1935-. Author, *Interpretation of Laboratory Findings*, 1936. Member, American

Medical Association; American Board of Pathology; American Association of Pathologists and Bacteriologists; New York Pathological Society.

Granet, Emil, Lieutenant Commander (MC) USNR (*The Treatment of Acute Proctological Conditions Afloat*, p. 635). A. B., Columbia College, 1921; M. D., College of Physicians and Surgeons, Columbia University, 1923. Internship, Bellevue Hospital, 1923; City Hospital, Newark, 1924-26. Instructor, medicine, College of Physicians and Surgeons, 1927-30; instructor, grad. med., Col. University, 1934-40. Assistant surgeon, proctology, Sea View and French Hospitals; assistant chief, gastro-enterology clinic, Mt. Sinai Hospital; proctologist, New York Hospital Out-Patient Dept. Fellow National Gastro-enterological Association; New York Proct.

Halprin, Harry, Lieutenant Commander (MC) USNR (*Abdominal Apoplexy; Report of a Case*, p. 811). M. D., University and Bellevue Hospital Medical College, 1923. Intern and resident physician, Mountainside Hospital, Montclair, N. J., 1923-25. Associate attending in medicine, Mountain Hospital; Chief, cardiac clinic, Mountainside Hospital; consulting cardiologist, Montclair Community Hospital; consulting cardiologist, Essex County Isolation Hospital. Member American Medical Association; Associated Physicians of Montclair and Vicinity; Essex County and New Jersey State Medical Society; American Heart Association; fellow American College of Physicians.

Heller, Austin N., Ensign, H-V (S), USNR (*The Sterilization of Water Mains*, p. 879). A. B., Johns Hopkins University, 1938; M. S., Iowa State College, 1941; graduate scholar, School of Engineering, Johns Hopkins University, 1938-39. Research assistantship, Water and Sewage Dept., N. J. Agricultural Experiment Station, 1935-38; research bacteriologist, Wallace and Tiernan Products and Co., 1942. Member American Water Works Association; New Jersey Branch, Society of American Bacteriologists.

Hennig, George C., Lieutenant (MC) USNR (*Reactivity of the Skin*, p. 698). A. B., Columbia, 1933; M. D., 1940. Intern, Presbyterian Hospital, New York City, 1940-42; research fellow, Welfare Hospital, New York City, 1942.

Humphrey, Arthur A., Lieutenant Commander (MC) USNR (*Suggestions for Mass Laboratory Examination of Recruits*, p. 849). B. S., University of South Dakota; M. D., Northwestern University Medical School, 1928. Resident, Iowa Methodist Hospital, Des Moines, Iowa, 1928-29; fellow in pathology, Mayo Clinic, until 1932. Laboratory director and consultant in pathology to the Lella Y. Post Montgomery Hospital, Community Hospital, and the Battle Creek Sanitarium of Battle Creek, Mich.; consulting pathologist to the Michigan Community Health Project through the W. K. Kellogg Foundation. Member American Medical Association; American Society of Clinical Pathologists; American Board of Pathology; Michigan Path. Society; State and County societies.

Irwin, F. Glenn, Lieutenant Commander (MC) USNR (*Spontaneous Rupture of the Kidney: a Case Report*, p. 818). M. D., Washington University Medical School, 1930. Internship, Barnes Hospital, St. Louis, 1930-33. Resident surgeon, Presbyterian Hospital, San Juan, P. R., 1933-35; director and chief surgeon, Presbyterian Hospital, San Juan, P. R., 1935-39; associate clinical professor, tropical medicine, Columbia University, 1935-38; associate professor, clinical surgery, Columbia University, 1938-39. Fellow American College of Surgeons; certified by American Board of Surgery, 1940; fellow American Medical Association.

Jacobs, Raymond G., Lieutenant Commander (MC) USNR (*Intra-abdominal Injuries from Depth Charge Blasts*, p. 816). B. S., and M. D., University of

Iowa, 1928. Intern, St. Louis City Hospital 1928-29; assistant resident surgeon, St. Louis 1930-33. Staff member, St. Mary's Springs Hospital and Enid General Hospital. Garfield County Medical Society; Oklahoma State Medical Association, American Medical Association; fellow American College of Surgeons.

Joseph, Thaddeus V., Commander (DC) USNR (*Toothache and the Aviator: a Study of Tooth Pain Provoked by Simulated High Altitude Runs in a Low Pressure Chamber*, p. 643). D. D. S., Creighton University, 1925. Demonstrator, operative dentistry, Creighton University, 1926. Instructor, 1927-29; assistant professor, 1930-35; associate professor, 1936-40, operative dentistry. College of Dentistry, New York University. Member American Dental Association; Dental Society, State of New York; First District Dental Society, New York City.

Knapp, Arthur A., Commander (MC) USNR (*Practical Points in Refraction*, p. 750). M. D., University and Bellevue Hospital Medical College, 1926. Assistant eye surgeon, New York Eye and Ear Infirmary; research ophthalmologist, Department of Pharmacology, Columbia University, for several projects during 1931-38; assistant visiting eye surgeon and ophthalmologist Arthritic Clinic, Hospital for Special Surgery (formerly Ruptured and Crippled Hospital); associate ophthalmologist, Montefiore Hospital for Chronic Diseases, 1931-40; director of eye service, Sing Sing Prison Hospital. Fellow American College of Surgeons; member American Medical Association; Association for Research in Ophthalmology; American Academy of Ophthalmology and Oto-Laryngology; New York Academy of Medicine.

Krueger, Albert P., Commander (MC) USNR (*The Inactivation by Human Skin of Influenza Virus in the Presence of Saliva*, p. 692). A. B., Standard, 1925; M. D., 1928. Assistant bacteriology and experimental pathology, Stanford, 1927-28; acting instructor, 1928-29; instructor and assistant professor, 1929; associate general physiology, Rockefeller Institute, 1929-31; associate professor, bacteriology, University of California, 1931-38, consultant communicable diseases, student health service, and lecturer medicine, medical school, 1932-. Assistant visiting physician University of California Hospital, 1931-, consultant bacteriology, 1932-; professor of bacteriology, University of California, 1938-; grant, cnt. scientific research, American Medical Association, 1938. A. A.; Society of Bacteriologists; Society of Experimental Biology; Society of Experimental Pathology; American Association of Immunologists.

Lebensohn, James E., Commander (MC) USNR (*Visual Rating, and Presentation of an Improved Unlearnable Letter Chart*, p. 744). B. S., University of Chicago, 1914, and M. S., 1915; M. D., Rush Medical College, 1917; Ph. D., Northwestern University, 1935. Ophthalmologist and otolaryngologist, U. S. Veterans' Hospital, Ill., 1921-24; assistant professor, ophthalmology, Northwestern University Medical School, 1929-. Attending ophthalmologist, Mt. Sinai Hospital, Chicago, 1921-; Cook County Hospital, 1937-; associate ophthalmologist, Illinois Charitable Eye and Ear Infirmary, 1925-37; visiting ophthalmologist, Frances Willard Hospital, 1921-. A. A.; American Academy of Ophthalmology and Otolaryngology; American Medical Association; fellow American College of Surgeons; Chicago Ophthalmological Society; Chicago Society for the History of Medicine; corresponding member Mexican Ophthalmological Society.

Leider, Morris, Lieutenant (MC) USNR (*Minor Pathologic Conditions of the Foot in Navy Personnel*, p. 764). A. B., University of Pennsylvania; M. D. Columbia University, 1933. Assistant, dermatology and syphilis, New York

Skin and Cancer Hospital, 1935-41. Member Kings County Medical Society; American Medical Association.

Levine, Alexander, Lieutenant (MC) USNR (*Common Neuropsychiatric Problems Encountered at a Naval Training Station*, p. 777). B. S., Columbia University, 1930; M. D., Long Island College of Medicine, 1934. Resident, neurology, Kings County Hospital, Brooklyn, N. Y., 1936-38; resident, psychiatry, Bellevue Psychiatric Hospital, New York City, 1938. Assistant alienist, Bellevue Psychiatric Hospital, New York City, 1939; junior psychiatrist, 1940; consultant psychiatrist, Pride of Judea Children's Home, Brooklyn, N. Y.

Master, Arthur M., Commander (MC) USNR (*Effort Syndrome or Neurocirculatory Asthenia in the Navy*, p. 666). B. S., College of the City of New York, 1916; M.D., Cornell, 1921. Cornell traveling fellow University Col. Hospital Medical School, London, 1924-25; adj. physician Mt. Sinai Hospital, New York, 1928-34, cardiographer, 1933, associate in medicine, 1934-41; electrocardiographer, clinic, medical college, Cornell, 1927-32. Cardiac consultant U. S. Veterans' Hospital No. 81, 1927-28; cardiologist Joint Disease Hospital, 1927-30; chief cardiac clinic, New York Hospital, 1928, assistant cardiographer, 1927-32, physician, out-patient department, 1933-41; assistant professor, clinical medicine, Columbia University, 1939-41. Member A. A.; American Medical Association; American College of Physicians; Society for Experimental Biology; Harvey Society; New York Academy of Medicine; New York Path. Society. Author, *Electrocardiogram and X-ray Configuration of Heart*, 2nd edition, 1942.

Quinn, Robert W., Lieutenant (MC) USNR (*Hyperventilation and Hyperventilation Syndrome*, p. 769). M. D., C. M., McGill University, 1938. Rotating internship, Alameda County Hospital, Alameda, Calif., 1938-39; intern, internal medicine, University of California Hospital, San Francisco, 1939-40; research fellow in medicine, assistant in medicine, University of California Medical School, San Francisco, 1940-41; resident in cardiology and assistant in medicine, Presbyterian Hospital, New York City, 1941.

Reingold, Morris, Lieutenant Commander (MC) USNR (*Pellegrini-Stieda Disease*, p. 800). M. D., Loyola University, 1919. Assistant visiting roentgenologist, Beth Israel Hospital, Boston; staff member, Lynn and Union Hospitals, Lynn, Mass. Diplomate American Board of Radiology; member American College of Radiologists; Lynn Medical Society; North Shore Medical Society; Boston Medical Society, Massachusetts Medical Society; American Medical Association.

Reynolds, Frank W., Lieutenant (MC), USNR (*Suggestions to the Naval Medical Officer for Talks on Venereal Disease; with a Catalog and Discussion of Other Educational Media*, p. 889). A. B., Colgate University, 1933; M. D., University of Rochester School of Medicine, 1937. Intern, Barnes Hospital, St. Louis, Mo., 1937-38; assistant resident, medicine, Barnes Hospital, 1938-1939; resident, medicine, Strong Memorial Hospital, Rochester, N. Y., July 1939-July 1940; assistant, Dispensary, and physician (Syphilis Clinic) and fellow in medicine, Johns Hopkins Hospital, Baltimore, 1940-41; instructor in venereal diseases, Johns Hopkins University School of Hygiene and Public Health. Diplomate National Board of Medical Examiners; Association of Military Surgeons; American Association for the Advancement of Science.

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BIMONTHLY



THE MISSION OF THE MEDICAL CORPS OF THE NAVY

•
**TO KEEP AS MANY MEN AT AS MANY GUNS
AS MANY DAYS AS POSSIBLE**

Issued Bimonthly by the Bureau of Medicine and Surgery
Washington, D. C.

VOL. XLI

JULY 1943

No. 4

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

Owing to exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of professional interest.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T MCINTIRE,
Surgeon General, United States Navy.

III

NOTICE TO CONTRIBUTORS

Contributions to the **BULLETIN** should be typewritten, double spaced, on plain paper and should have wide margins. Fasteners which will not tear the paper when removed should be used. Nothing should be written in the manuscript which is not intended for publication. For example, addresses, dates, etc., not a part of the article, require deletion by the editor. The **BULLETIN** endeavors to follow a uniform style in heading and captions, and the editor can be spared much time and trouble, and unnecessary changes in manuscript can be obviated if authors will follow in these particulars the practice of recent issues.

The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have them typewritten.

In submitting articles for publication either in the **BULLETIN** or in other journal, the author should include a signed statement to the effect that "the opinions or assertions contained therein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large." (Art. 113 (2) U. S. Navy Regulations.) If forwarded for publication in other journal the article must be submitted in duplicate, one copy being retained in the Navy Department files.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized. Recognizable photographs of patients should carry with them permission to publish.

The **BULLETIN** intends to print only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.

The editor regrets to have to say that reprints of articles can no longer be supplied by the Government Printing Office.

ROBERT C. RANDELL, *Editor,*
Commander, Medical Corps,
United States Naval Reserve.
STEPHEN A. ZIEMAN, *Assistant Editor,*
Lieutenant Commander, Medical Corps,
United States Naval Reserve.

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U. S. NAVAL MEDICAL BULLETIN

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SPECIAL ARTICLES

EVACUATION OF WOUNDED BY AIR FROM THE BATTLE OF GUADALCANAL

TOM T. FLAHERTY

Lieutenant Commander (MC) U. S. N.

WILLIAM D. YAVORSKY

Lieutenant (MC) U. S. N.

NORMAN L. YOOD

Lieutenant (MC) U. S. N.

and

JOSEPH G. McWILLIAMS

Lieutenant (MC) U. S. N.

On August 23, 1942, the advance echelon of MAG-25, consisting of 14 R4 D1 (DC-3) airplanes, departed for combat duty beyond the seas. Because of the weight restrictions made necessary by the prolonged flight, only 78 pounds of medical equipment and one flight surgeon accompanied this group.

This advance echelon arrived at its operating base in the South Pacific area on September 1, 1942. The first flight into the combat zone was made the next day. The evacuation of wounded was started immediately, although at this time the medical personnel to man the planes had not yet had time to reach the combat zone.

The planes were equipped with facilities to carry 18 stretcher cases; however, installation of the auxiliary cabin tanks required for prolonged flights over water reduced the number of stretchers to 10. Most of the medical equipment was sent by surface ship, and, as in the case of the medical personnel, had not yet arrived.

For the first 6 weeks there was no regular medical supervision for the loading of casualties in the combat zone, and the facilities for the handling of patients at the unloading terminals were being organized. Early in October medical personnel was added to the crews of the planes. On November 1, 1942, sufficient of these were made available to place a flight surgeon on that plane in each day's flight which was to carry the more seriously wounded, and a hospital corpsman on each other plane.

At this time a clerical section was established and accurate records began to be kept of the evacuation program. Prior to this time prac-

tically no accurate records were kept and only an estimate can be given of the number of patients evacuated during the month of September. During that period, many flights were made into the combat zone. During later months, for which accurate records are available, no fewer than 12 patients on the average were evacuated per trip.

Although evacuation of wounded by air was practiced during the Spanish Civil War, and has been continued by various nations in Europe, this is, perhaps, the first instance of the mass evacuation of casualties in specially fitted land planes flying great distances over water.

The fact that only two patients died in the air proves the feasibility of air evacuation. Our statistics show that practically all types of injuries and diseases have been evacuated safely.

It is felt worth while to discuss a few of the injuries and diseases evacuated by us which, in the past, have been considered as rendering a patient unfit for travel by air.

We have found no contraindications to the transportation of head injuries at altitudes below 10,000 feet. Recent articles have stressed the need for oxygen with increased intracranial pressure. Yood accompanied a patient with known pressure of 300 millimeters of water a distance of 1,000 miles. This involved 8 hours flying time at altitudes up to 10,000 feet and at a mean altitude of 6,000 feet. The only difficulty encountered was nausea and vomiting while flying through a front with excessive air turbulence.

One patient was removed by air 12 hours after complete debridement of a compound depressed skull fracture of the left temporal region. No medications were required during the 5½ hours of flying at altitudes between 8,000 and 10,000 feet. Pulse and respiration remained within normal limits during the flight.

Psychotic patients react poorly to air transportation. This is felt to be due to the irritation caused by unfamiliarity with surroundings, poor orientation, fear of flying, presence of wounded, and the fact that the space in the plane is rather cramped. All psychotic patients are potentially dangerous to other personnel and to themselves while in flight and hence are restrained. This is, no doubt, a factor which adds greatly to their irritability. We have found no correlation between altitude and degree of irritability.

One hundred and eighty-nine psychoneurotic patients have been evacuated by air and have presented no problem while in flight. It is possible that departure from the combat zone, presence in which has been the precipitating factor in the development of their illness, is in itself a contributing therapeutic measure.

Many chest cases have been evacuated by air. In most instances the specific type of injury is not known by the flight surgeon on the

plane. On the whole, only moderate dyspnea has been encountered below 4,000 feet. Oxygen has been used only with dyspnea and not prophylactically. With chest cases flights have been made at altitudes below 1,000 feet unless weather conditions demanded higher altitudes for safety of the ship.

McWilliams reports one patient with a left pneumothorax who was flown at 4,000 feet for a period of 2 hours, during which time the patient was sleeping comfortably. Sudden extreme dyspnea awoke the patient. The pulse at this time was full and of good quality, with a rate of 90. Oxygen was immediately given but with poor response. The plane was immediately let down to 500 feet but the dyspnea persisted. Two hours were required to complete the flight, during which time oxygen was given continuously and the plane was flown at 500 feet, but the patient went into shock, and was in severe shock at the termination of the flight. Death occurred 45 minutes after arrival at a hospital. This sudden dyspnea and collapse was found to be due to intrathoracic hemorrhage occurring during the flight. An attempt was made to administer plasma on the plane, but because of collapse of the veins, this could not be accomplished.

Although statistical data by diagnosis show only eight chest cases evacuated, a great many more have been evacuated under the diagnoses of gunshot and shrapnel wound.

The majority of acute abdomens have been evacuated postoperatively. Those not complicated by peritonitis or an ileus have withstood travel by air well. Those complicated by a peritonitis or an ileus have developed shock at altitudes above 5,000 feet.

Flaherty states that in one instance, where weather necessitated flying at 7,000 feet for 1 hour, a patient with generalized peritonitis, following a gunshot wound, developed shock. Return to 500 feet was accomplished as soon as possible but the patient showed no improvement, and death resulted in a period of 1½ hours.

It was found that burn patients who had received treatment for shock for at least 24 hours prior to evacuation presented no serious problem. Those patients not properly treated for shock, and evacuated under 24 hours, have developed shock, dyspnea, and cyanosis at moderate altitudes. However, all burn cases required a great deal of special attention to keep them comfortable. Fluids by mouth are tolerated poorly. Vomiting results if more than small sips are given.

Cases of bronchial asthma have been evacuated and have presented no problem at altitudes up to 10,000 feet.

Contrary to the opinion expressed in a weekly periodical during December 1942, no difficulties have been experienced with patients receiving sulfa drugs. In practically all cases of gunshot and shrapnel wounds, sulfa drugs have been used freely prior to evacuation.

Secondary anemias such as those caused by malaria, malnutrition, and infection have withstood altitudes of 8,000 to 10,000 feet with no difficulty.

Fractures of various types have been evacuated. The majority have been transferred with the use of Thomas splints. These cases have been comfortable, especially if their stretchers were placed on the deck or in lower bunks where adjustment to the splints could be accomplished easily.

DISCUSSION

Our planes fly at an altitude ranging from 500 to 10,000 feet, usually either near 500 feet or at 7,000 to 10,000 feet. Acute chests and abdomens are the conditions most likely to be affected adversely by high altitude. However, these are not likely to be affected any more by air transportation at 500 feet than by surface transportation, and flight at 500 feet is nearly always practicable over water.

When higher altitudes must be used, the effects thereof on patients with chest injuries can be minimized by administration of oxygen. However, no effective means is available of countering the action of high altitudes in promoting intestinal distention in patients with peritonitis or ileus.

Table 1.—Medical Department equipment and supplies aboard each ambulance evacuation plane

One bottle of aspirin tablets (100).	Plasma, 2 units.
Adhesive tape (one 3-inch roll).	Sulfanilamide, pulverized, 5 packages (5 grams each).
Alcohol, denatured, 2 bottles (2 ounces each).	Sulfanilamide, tablets, grains 5 (2-ounce bottles).
Ammonia ampules (1 box of 5).	Sulfathiazole, tablets, grains 3.8 each (2-ounce bottles).
Bandages (rolls of 2- and 3-inch).	Sputum cups.
Battle dressings, large (2).	Tannafax (burn jelly) 1 tube.
Battle dressings, small (2).	Tongue depressors.
Compress bandages (2).	Quinine sulfate (100 tablets).
Cotton, absorbent, package.	Bed pan.
Gauze.	Urinal.
Iodine, 1 bottle (2 ounces).	Spray gun and insecticide (malaria control).
Morphine Syrettes, 2 packages (5 each).	

Where high altitude may be associated with low temperature it is important that the cabin be adequately heated.

Subject to the above exceptions it may be stated that almost any patient may be successfully evacuated by air if he is in condition to travel at all.

On the other hand, irrespective of the nature of his illness or injury, a patient who is in shock or in a condition susceptible to shock can no more be safely transported by air than he could be by land or water. Although oxygen and plasma have many times been administered in the air, the poor access to the patient, the close quarters, the uneven movement of the plane, and the lack of assistance make the treatment of shock difficult.

The three most valuable therapeutic aids to be administered on the plane are found to be morphine, blood plasma, and oxygen.

In addition to these items, each plane carries all articles listed in table 1. This equipment, although not elaborate, has proven to be compact and adequate. All articles listed (except bed pan, urinal, and spray gun) are contained in an opened-faced canvas roll hung on a bulkhead.

SUMMARY

During a period of 5 months * * * patients were flown to hospitals 5 hours (700 miles) away, with 2 deaths occurring during flight.

We found no contraindications to altitudes below 3,000 feet, and these altitudes were usually possible although they did slightly increase the flying time. However, weather and mountains occasionally did necessitate higher altitudes. Shock or potential shock proved to be a contraindication to any type of transportation.

The transportation of chest injuries above 3,000 feet is not without danger, and we believe that a higher altitude of 4,000 feet may have been a contributing cause of intrathoracic hemorrhage and death in one such case.

Since weather and mountains sometimes required an altitude in excess of 3,000 feet, it was recommended to postpone airplane evacuation of gastro-intestinal perforations until postoperative tympanites had disappeared, as again a higher altitude was a contributing cause of death in at least one patient with generalized peritonitis who developed shock at 7,000 feet.

It was also recommended to postpone the evacuation of extensive burns until 24 hours of treatment for shock had been administered, as otherwise shock sometimes developed in the plane where ideal treatment is difficult at best.

Patients administered sulfa drugs and patients with profound chronic anemia withstood altitudes of 10,000 feet well.

The three most valuable therapeutic aids to be administered on the plane were found to be morphine, blood plasma, and oxygen. Cabin heat is desirable.

CONCLUSION

In determining the safety with which a patient can be transported by air, his general condition is more important than the particular nature of his disease or injury.

RECOMMENDATIONS

1. A medical officer should be in charge of selection and loading of patients. He must see and evaluate all cases. This has been demonstrated by the fact that no case was lost in the air when a medical officer had this close supervision over loading.

2. Patients should be fed, and urged to urinate and defecate prior to being placed on the plane.
3. In trips lasting over 4 hours all patients show weariness, irritability, and discomfort, and it is felt that trips lasting over 5 hours are undesirable.
4. Abdominal cases should not be evacuated until several days after operation.



FLIES

To most of us, "fly" means the common housefly (*Musca domestica*), and this variety is the one we usually see, but the number of varieties of flies is legion and many of them are exceedingly destructive to human and animal life, directly or indirectly. The ordinary housefly is dangerous through its filthy habits and the ability to spread infections of all sorts by bacteria, which it is ideally built to distribute with its hairy body and sticky feet. These flies do not bite. If flies bite, they are not houseflies.

Biting flies may kill thousands of cattle annually, and make life miserable for men. Others may ruin many hides by numerous perforations, caused by the exit of larval forms. Some deposit eggs in the noses of animals, or even of men, and cause great distress or death.

The bot flies are pests to almost all domestic animals, sometimes disastrously so. The tabanid (horse) flies will drive animals frantic and often kill stock by the great amount of blood drawn. Their bites are painful and may transmit anthrax.

The transmission of typhoid fever and intestinal infections to man by house or other flies is well known. They have been accused of transmitting poliomyelitis, and this now seems to have been confirmed. In Africa, the tsetse flies have depopulated large areas, and have threatened all human life in other localities through sleeping sickness.

A partial list of the diseases that have been definitely proved to be conveyed by flies includes cholera, typhoid fever, dysentery, diarrheas, tuberculosis, tularemia, filariasis, ophthalmia, trachoma, yaws, tapeworms, sleeping sickness, and myiasis.

Flies are practically everywhere, and if it were not for numerous insects, birds, animals, fish, and reptile enemies, no human life could exist on account of these and other insects. But we need still more protection than these afford, and while we cannot eliminate flies, they can be largely controlled by proper sanitary methods, which consist of preventing their breeding and eliminating their food supplies.

It is possible to almost eliminate flies by screening, removal of organic matter (garbage, manure, lawn clippings, etc.), and by preventing their access to food. Poisoning, trapping, adhesive flypaper, and swatting are other measures that assist in the fight, but the greatest dependence must be upon prevention.—Skinner, F. A.: Insects, ticks, and works in human medicine. Clin. Med. 49: 327-330, Nov. 1942.

COMBAT FATIGUE AND WAR NEUROSIS ¹

GEORGE N. RAINES

Lieutenant Commander (MC) U. S. N.

and

LAWRENCE C. KOLB

Lieutenant (MC) U. S. N. R.

Much has been written on the "war neuroses", some descriptive, volumes statistical, a great majority interpretive and dynamic, very little that can be applied directly to these problem cases by the medical officer of general training who must handle them in their critical stage. Agreement has not been reached even on the answer to "What is a war neurosis?" Certainly all are agreed that the usual psychoneuroses encountered in peacetime should not be termed "war neuroses" simply because they occur in a war setting. Removing these, we are left with a group of cases which do not conform entirely to the nosological criteria of psychoneuroses, and which can be classified as such only with some difficulty. It is this group of cases in which we are interested, actually presenting more a question of psychoneurotic symptoms in previously stable persons, than of true psychoneuroses. We are confronted at once with the problems of what to call these cases and how to delineate clearly the syndrome variously called "war neurosis," "traumatic neurosis," and, of late, "combat fatigue." These three terms are used interchangeably throughout most of this paper, with some discussion later as to which is the most acceptable. None seem to us particularly desirable, descriptive, or accurate, any more than the "shell shock" of the first world war, but we are forced to admit that we have no better suggestion to make.

Rado has considered the "traumatic neurosis" a result of the breakdown of the normal "emergency control" mechanisms of the personality by an overwhelming trauma, and in therapy suggests the desensitization of the patient to the traumatic experience. Gillespie has considered some of the symptoms in the light of a "conditioned response" to the noises of battle, especially the so-called "startle reaction" (start-

¹ The authors present this article to those doing the general work of the Navy with the idea of summarizing for those outside psychiatry certain facts concerning "war neuroses," so that they may be available for practical application. The work of others has been borrowed from freely; the experience is our own. The cases cited have been contributed by all the members of the neuropsychiatric staff of the Norfolk Naval Hospital, Portsmouth, Va., who should be recognized as coauthors: Lt. Comdrs. S. M. Smith, W. B. Cline, L. A. Schwartz, and Lt. D. T. Dodge, all of the Medical Corps, U. S. Naval Reserve.

ing, tremulousness, palpitation, and fear, on sudden noise). With this in mind, McLaughlin and Millar have used recordings of combat noises as an adjunct to psychotherapy of war neuroses, with reported good results. Kardiner has presented an extensive monograph based on the careful study of chronic cases from World War I, and has attempted to separate the group as an entirely different type of psychoneurosis, which he considers with the psychosomatic neuroses as "physioneuroses." He points out, as pathognomonic, repetitious catastrophic dreams, especially dreams in which essentially the traumatic situation, or a portion thereof, is re-enacted. Autonomic phenomena are common, as are psychosomatic complaints. The startle reaction is extremely frequent. As psychologically traumatic in origin, Kardiner groups a great variety of cases varying from anxiety states to schizophrenia and epilepsy, from a clinical point of view having in common only the listed symptoms, and the fact that each had its onset following a traumatic experience. For the chronic cases, suggested therapy is based primarily on a prolonged psychotherapeutic procedure, and removal of secondary gain from the neurosis by overhaul of the pension system. For the acute cases, rest, a sympathetic atmosphere, and the discharge of emotion from the traumatic situation are suggested. In Kardiner's opinion, the last should be accomplished at the conscious level by interview, rather than by abreaction under hypnosis as was commonly practiced in World War I.

A most valuable contribution to the literature from the current war, has been made by Sargant and Slater in an article on the "Acute War Neuroses" encountered following Dunkirk. Their cases demonstrated "that men of reasonably sound personality may break down if the strain is severe enough." They were of the opinion that while their cases may have had some predisposing constitutional factors in comparison with the average population, they nonetheless had made a satisfactory adaptation to army life, and the previous history indicated in most cases a man of normal intelligence, personality, and work record. The stress required to produce a break-down of such personalities was of an altogether different order from any to which they could expect to be subjected in ordinary life. The patients presented signs of marked physical exhaustion, and mental symptoms of "anxiety, sleeplessness, terrifying bad dreams, a feeling of inner unrest, and a tendency to be startled at the least noise." "The course taken by these patients under treatment was uniformly toward improvement."

By far the most significant publication for those dealing with these problems in a naval service, is the recent article by Margolin, Kubie, Kanzer, and Stone entitled "The Nature and Incidence of Acute Emotional Disturbances in Torpedoed Seamen of the Merchant Marine

Who Are Continuing at Sea." A common type of acute neurotic reaction seen in land combat was not encountered in this study, i. e., the acute panics and stupor reactions, it appearing that these men did not survive the sinking of their ships. Even with such cases eliminated, the investigation met with persistent symptoms of some degree in 75 percent of the men examined, an inordinately high occurrence. Of these, only one third, or 25 percent of the total examined, showed sufficiently severe reactions to be disqualified for return to sea as psychoneurotic. Besides admitting that the number of men examined is small (40), the authors attempt to qualify the high incidence of emotional disturbances by pointing out certain predisposing factors in the personalities involved, in particular the psychological problems which had driven many of the subjects to the sea as a means of livelihood, and the improper and inadequate training which many of them had received for certain phases of combat duty. Nonetheless, the fact remains that in the first carefully conducted study of men subjected to the stresses of naval combat, a tremendous incidence of "neurotic" symptoms has been encountered.

The psychiatric screening program of the Navy will undoubtedly reduce the incidence of "neuroses" considerably over that reported above, but unfortunately no one has as yet been able to formulate any definite criteria for the rejection of men suspected of being predisposed to "traumatic neurosis." Symptoms occur inexplicably in men who by all concepts are well within the limits of normal personality. The most careful studies have not revealed a personality structure common to these multiple cases. What personal problem could 3 out of 4 men carry to produce the same or quite similar symptoms? Why, as reported by Love, do "individual infantry units of approximately equal standards of training and stress show notable divergencies in the number of neurotic casualties"? Extremes of 1 case and 27 cases admitted from equal infantry units are reported. Is any group of men so maladjusted that it can produce 75 percent of its number with a neurotic syndrome? Under such circumstances the abnormal becomes the normal, and what at first glance appears pathological may at second clearly be physiological. It is our belief that the psychological mechanisms associated with "traumatic neurosis" are so fundamental as to be present in all men, and are of concern only in determining the extent of the neurotic response, not its content. As a corollary, the precipitating force lies in the personality's environment, hence to some extent is controllable. These are primary facts in preventive and curative therapy.

The ordinary psychiatric problems of peacetime occur regularly in the setting of war and take coloring from the combat situation, usually in the form of the cardinal symptoms of "war neurosis."

These cases must be set aside in their own group; they are irrecoverable to the military service. Their backgrounds are those of the psychoneurotic; childhood insecurity, parental rejection, faulty inheritance, early evidence of maladjustment, and immaturity. In war they are curable exactly as are their peacetime counterparts. They require extensive and prolonged psychotherapy. As far as the Navy is concerned, they must be evacuated as rapidly as possible from combat areas and discharged from the naval service for therapy at the governmental agencies established for that purpose. In spite of their combat seasoning, it is difficult to classify them as "war neuroses," and in handling them the feeling is always present that the patient would have reached his current degree of disability under almost any environmental condition. Examples are given later on in this paper. Of especial interest to us is that under certain conditions, a profound psychoneurotic can pass through combat experience, show no handicap during action from his illness, emerge disabled by his psychoneurosis, but with no evidence of any "traumatic neurosis." The increased responsibility of a promotion may render such a man disabled after he has weathered combat experiences known to break others. It is in the separation of the psychoneurotics with traumatic coloring that the medical officer must be prepared to exhibit a great degree of diagnostic sensitivity.

The characteristic symptom of the "traumatic neurosis" is undoubtedly the "repetitious catastrophic nightmare." In its absence the diagnosis is suspect. It usually reenacts the traumatic scene, or some portion thereof. It is always accompanied by a pathognomonic, childlike emotional pattern; the effect of fear persists even after awakening, so that the patient feels compelled to leave his bed, walk around, seek human companionship. In the adult this combination of events is rarely met except in the "traumatic neurosis."

Closely following the nightmare in frequency is the "startle reaction." Sudden loud noises, by day or by night, produce in the unhappy victim a sudden start, accompanied by the physiological evidence of anxiety; tremor, dilated pupils, sweating, dry mouth, flushing or pallor, palpitation. Not infrequently, in the more acute stages, the startle reaction breaks over into actual panic; the patient runs for the nearest exit, or screams hysterically, or upsets nearby furniture, or stands transfixed laughing and crying uncontrollably. This panic is extremely contagious among other members of the ship's crew, and is the most generally disturbing external evidence of the war neurosis. One ship returning with the survivors of a torpedoed transport crew, unfortunately had a loose hatch cover over the living compartment in which they berthed. Each time a sudden movement of the ship caused the cover to slap, the entire group of survivors made a panicky start for the lifeboats, many from a comparatively sound sleep. Four

of this group were admitted to this hospital immediately after arrival in the United States. It is because of this startle reaction that other ships find it extremely difficult to assimilate survivors of certain ships into their own crews. Five cases were admitted from such a ship after they developed acute panics during target practice. All were in different parts of the ship, from the bridge to the engine room, and their total effect was so disturbing that the commanding officer directed the medical officer, "For my sake, get them off of here."

Accompanying these symptoms is what has been described by Kubie as "a subtle personality change." The victims lose their cheeriness, become morose, silent, sullen, irritable, intolerant of noise or argument, withdrawn. Not infrequently they show a peculiar vacant staring expression that suggests the affectless facies of the schizophrenic. Alcohol is very commonly resorted to as a relief from the psychic torture which they endure. Because of their neurotic symptoms, many become disciplinary problems. A quiet, well behaved, although somewhat immature Marine aviator tells his colonel in no uncertain words where the latter can put his squadron of planes; a coxswain with 3 years of service, having never been on report, is A.W.O.L., and returns only when his family finds out he is not on leave, becomes worried over his mental symptoms and brings him back. The personality change is a subsidiary rather than a cardinal symptom, as the nightmare and startle reaction, and is the most variable feature of the illness. It may be scarcely noticeable, or it may be profound. It may be a symptom of "war neurosis," or it may in itself be indicative of a major psychoneurosis or psychosis.

Accompanying these symptoms frequently is a fourth clinical manifestation which is not essential for the diagnosis, but is extremely common, a guilt reaction with emotional depression. As noted by Kubie, "Perhaps the worst situation occurs whenever a group of men are trapped in a spot from which only a few can escape. Escape from such a predicament leaves the survivors haunted by the memory of those who were left behind, with a sense of guilt as great as if they had murdered them." In lesser degree, this feeling of guilt, with its consequent emotional tone of depression, occurs in many survivors of disasters in which a number of the original group were lost, regardless of the circumstances of survival. The higher the percentage of the original group that is lost, the greater is the possibility of the appearance of guilt in the survivors, and on occasions the guilt appears to be lessened to some degree by hardships which may have been endured to survive. In addition to revealing itself in depression, the sense of guilt leads to protestations that nothing could have been done by anybody for those who were lost, and to the survivor's careful exposition of his own efforts to save others.

We believe that the traumatically determined emotional disturbance in itself goes no further than these symptoms; beyond lies the true psychoneurotic, easily diagnosed by longitudinal history. In the presence of conversion hysteria, marked free anxiety, neurasthenia, compulsions, and obsessions, or psychosomatic manifestations in the cardiovascular, gastro-intestinal, or other organ systems, we have invariably found one of the classical psychoneuroses.

For our purposes, then, we have established four arbitrary criteria for the diagnosis of "war neurosis," or "combat fatigue":

1. *A stable personality prior to appearance of the traumatically determined emotional disturbance.*—There should be no objective evidence of maladjustment in childhood or adolescence. Walking, talking, habit forming, should have occurred at about the usual age. The school and work record should indicate stability, without undue disciplinary problems having arisen, without frequent changes in employment, without undue conflict with civil authorities, without unusual revolt against parental discipline. A normal heterosexual adjustment should have been reached if the patient is of sufficient age. In this respect, medical officers are warned against paying too much attention to minor variations, except after comparing these rigidly with the personality traits of men similar in age and background to the one under study. Cultural differences of various parts of the country must be recognized in this connection.

2. *A combat experience of sufficient intensity to render it feasible as a precipitating agent.*—The mere threat of combat is not enough to produce neurotic symptoms in men other than those specifically predisposed, i. e., the psychoneurotics. The combat experience should be examined carefully in its relation to the patient; there is no direct relationship between the severity of the experience and the severity of symptoms. Here the personality of the individual undoubtedly contributes to the picture, in the amount of reaction produced by a stimulus. Thus, a boy rejected by his father in childhood will be much more profoundly affected by the loss of a superior petty officer or officer whom he has accepted as a father substitute than would a shipmate, otherwise similar, who had needed no such substitute. The environmental setting should be examined with particular care, with special reference to certain contributing factors such as what did the patient think of his officers, how well did he know his job, how well did he know his shipmates, what were his relations with the human beings around him and with his ship, and how much did he suffer with physical fatigue.

3. *Objective evidence of subjective anxiety.*—The patient suffering with war neurosis does not discuss his combat experience with equanimity. He sweats, he trembles, he flushes or pales, he swallows fre-

quently, he smokes incessantly. No malingerer can imitate successfully the delicate timing of the physiological effects of anxiety. When the battle description rolls out smoothly, search more carefully for a psychoneurosis or a psychosis.

4. *Recoverability*.—It is our belief that all true “war neuroses” will recover in a comparatively short period of time with even relatively superficial therapy. When symptoms persist in disabling degree beyond 2 months under treatment, either the treatment is not adequate, or the psychoneurosis is not simply “combat fatigue” and has its roots in a deep-seated emotional conflict which long antedated the traumatic experience. By recovery, we mean the disappearance of nightmares, startle reaction, and the symptoms of personality change previously mentioned. Objective evidence of anxiety disappears from the combat discussion. These people are extremely sensitive to war movies reproducing battle scenes and sounds; so much so that the sensitivity can be used in differential diagnosis, and as evidence of recovery. When such a patient can sit through actual combat scenes in the movie, without feeling anxiety or tension, without having to leave or feeling unduly restless, without feeling depressed afterward, and without resultant dreams, he may be considered fully recovered from the traumatic experience. This testing must be used carefully; the sensitivity to movies persists long after all other symptoms have subsided. One of our patients had over 5 years in the Navy, in spite of having walked in his sleep on many occasions in his life, at least nine times after enlistment. Following the sinking of his ship in June 1942 he suffered with nightmares and startle reaction for a period of 6 weeks, but did not seek medical care. In February 1943, long after the subsidence of all his symptoms, and his apparent complete rehabilitation to the service, he attended the war movie “In Which We Serve.” He felt depressed and restless afterward, and that night his “catastrophic nightmare” recurred for the first time in 7 months. He arose from his bunk, asleep, and actually abandoned ship by leaping over the side. He later stated with some humor that he awakened in mid-air, but it was too late to go back.

When these criteria are satisfied, we deal with a group of patients who may be saved for further military duty, although their reaction to combat, even after recovery, may preclude their return to actual line duties at sea. The war is yet too young for adequate statistics to govern the complete handling in these cases, but it is believed that even relatively severe cases which do not go beyond the stated boundaries will adjust adequately to limited duty, and eventually probably will be able to endure actual combat. We know that even the mild cases must be given a period of time in which to “digest” the emotional trauma incurred before again being exposed to combat

conditions; repeated traumatic experiences at too short an interval increase the severity of the ultimate disability.

In the etiology of the "traumatic neurosis," the personality, as has been stated, is chiefly of importance in determining the severity of the neurotic symptoms under a given stimulus. In this connection we find two personality types, diametrically opposed to one another, which appear to be of greatest importance in predisposition and which suggest a bad prognosis. These are the emotionally and intellectually immature persons, with a great deal of dependence, and at the other end of the scale, the fully matured, independent older men. While there is no direct correlation between chronological age and emotional maturity, the personalities usually associated with age below 18, and above 38, comprise this group which appear to be particularly susceptible to the combat situation. It is not meant that those in the intermediate groups are not susceptible, or that these types inevitably suffer traumatic neurosis. Other factors being equal, the younger and the older men are the most disturbed emotionally by combat, and recover more slowly.

Of more direct importance in the production of symptoms is the setting of interpersonal relationships in which the traumatic event occurs. In the patients' own stories of the precipitation of neurosis four factors have occurred, singly or grouped, in too great frequency to be ignored:

1. *The patient entered combat without faith and confidence in his leader.*—This may be petty officer, commissioned officer, commanding officer, division commander, force commander, or higher, depending on the rank and duties of the victim. This arises from any one of several situations. The superior may be incompetent, or being competent, may have given the impression of incompetency to his juniors. The important point is not the actual ability of the superior, but the junior's estimate of his ability. The leader may have held his position for such a short period of time before combat that his juniors are uncertain and in doubt as to his ability; on the other hand, he may, through familiarity with his troops, have exposed his normal weaknesses in extramilitary matters, thus casting doubt in the minds of those under him on his ability to command. It is this latter possibility which makes urgently necessary the restraint of normal personal relationships between officers and the men who will serve under them in combat. Any incident which strengthens faith in the leader lessens the occurrence of neurotic symptoms, hence a winning army or a winning ship produces fewer cases than one which loses. A ship which has given a good account of herself, even though finally sunk, leaves a less emotionally disturbed group of survivors. Similarly, loss of faith in leadership, even after combat, may produce symptoms

based on the previous traumatic experience. Thus a yeoman who survived the sinking of a combatant ship under extremely traumatic personal circumstances (personally witnessed loss of close friends, great danger to self, and long hours in the water) had no reaction noticeable to himself more than mild startle response until he began to prepare the reports of the engagement. He then discovered that mistakes had been made in the conduct of the engagement, and immediately developed nightmares, restlessness, and anxiety in response to noise.

From the standpoint of the patient, his lack of faith may arise from his own considerable ability as compared with the lack of experience and youth of the officers under whom he serves. This may account to some extent for the predisposition contributed by age; with greater maturity greater value is placed on life, there is less belief in the infallibility of humans, a more critical perceptive toward all is adopted. The rapid expansion of the Navy may give us many ships in which the officers are of less experience and younger than many of their crew, a potentially dangerous situation psychologically.

2. *The patient was insufficiently trained, did not know his job or his ship as thoroughly as he should.*—Careful and adequate training is of the utmost importance in prevention of war neurosis. All observers agree that in the heat of battle men react at an automatic level; they do what they have been taught to do, and nothing else. When a gun platform was on fire, ammunition handlers who had been trained to overboard ready ammunition in case of fire continued to dispose of it properly even when the men about them were blown to bits performing the same duty. At least some of the patchy amnesias for combat details are due to an attention defect at the time, rather than to active repression of unpleasant memories. Such amnesias, when the events are recovered, reveal themselves as of no particular importance to the patient or his illness. It appears that complete training will greatly reduce the incidence of acute psychiatric casualties during combat, as well as more protracted illnesses later. Fear reactions are much less common in those performing duties they know well, even though the duties themselves may not provide an outlet for aggression or the normal anxiety experienced under fire. This has been noted by others, and Sargant quotes a high military authority as stating that, "Shell shock is nothing but insufficient training."

3. *The patient entered combat surrounded by new shipmates, men who were comparative strangers to him, and whose conduct under fire he had not had time to estimate.*—In this respect a man is between two fires; if he is among close friends of long acquaintance, he is emotionally wrung by witnessing their maiming and destruction; if he is among new shipmates his own sense of personal danger

is greatly enhanced. The latter situation is the more intolerable to him. Ships with hurriedly assembled crews, or with high percentages of new men on board, may be expected to contribute an unduly high number of "war neuroses."

4. *The patient experienced the combat situation when he was suffering with marked physical fatigue.*—The outstanding role of fatigue in all these syndromes has been recognized and stressed by each investigator of the subject. Whatever the usual mechanisms of defense against this type of emotional disturbance, it is certain that they are weakened and reduced by prolonged physical exertion, hunger, exposure, lack of sleep, irregular habits. Fatigue is particularly important in land troops; the men of naval forces are more apt to have some opportunity for rest between engagements. Such rest, however, may be broken by general alarms, drills, abortive attacks, and so on, so that it falls considerably short of true rest. "War neurosis" may be expected much more commonly among land troops, but conversely, such symptoms as occur may be expected to respond much more readily to simple rest. Fatigue has been such a prominent part of the etiological background of these cases, that it has been suggested as an alternate name for this syndrome which scarcely qualifies for the diagnostic title of "neurosis."

We are not prepared to say just why the above factors produce symptoms. Complete analysis of a number of such cases would undoubtedly reveal certain fundamental psychological mechanisms through which the symptoms are produced. It is our belief, however, that any such psychological mechanisms as exist are common to a great majority of men, that their eradication is impossible, and that therefore their importance can be minimized in the prevention and treatment of "war neurosis" in the present state of our knowledge. We believe that the four factors delineated above can be controlled to some extent, and thus utilized in the prevention of "war neurosis" or combat fatigue.

Two other observations concerning etiology, especially important therapeutically, are the facts that: (1) Difficulty in returning a patient to combat duty is increased in direct proportion to the distance from the front to which the patient has been evacuated, and (2) all symptoms are liable to aggravation in the presence of loved ones; friends, relatives, spouse, family. In the latter situation, the traumatic anxiety and concomitant disturbances are particularly apt to attach themselves to the emotional ramifications of family life and become irreparably fixed. A patient who suffered with nightmares of some degree, and moderate startle reaction, found it unnecessary to consult a physician concerning them for 3 months after the sinking of his ship. During this period he was busily engaged in the affairs

surrounding decommissioning of the ship and was quite able to handle his nervous reactions without outside aid and without undue concern on his part. Immediately following his return home on survivor's leave, 3 months after the sinking, he was met with newspaper publicity, innumerable calls from the families of other men from the same town who had been on his ship, and within 24 hours was suffering such attacks of anxiety that he called his family physician for examination. In this particular case, the man was especially foresighted in that he returned at once to naval command when his physician informed him that he probably had "heart trouble." The efficacy of therapy is shown in the fact that he now is back on limited active duty, in spite of receiving only the most superficial sort of treatment. Less fortunate patients remain in the vicinity of their families, and may easily ripen their transient symptoms into a full-blown psychoneurosis in the misguided warmth of love.

It is extremely difficult for those accustomed to working with psychoneuroses to consider the "war neurosis," as delineated herein, a true neurosis. The occurrence of psychoneurotic symptoms in an otherwise stable and nonneurotic personality is a remarkable and striking phenomenon, one which will bear careful study and observation. This collected group of symptoms does not occur in isolated form in the personality; they may be incorporated with underlying emotional conflict to form any gradation of a true psychoneurosis, with fundamental mental deficiency to produce a bizarre picture, with an incipient psychosis of either the affective or schizophrenic type, actually even with organic brain damage or with epilepsy. It is this incorporation, however, which produces the wide variety of response to combat conditions, and not the traumatic emotional disturbance itself. The universality of the picture, the stereotypy of the symptom response, the extremely shallow depth of the uncomplicated cases, the absence of previous marked emotional disorder in so many victims of "war neurosis," all suggest that here we are dealing with something quite different from the usual psychoneurosis. Names such as "war neurosis," "traumatic neurosis," "traumatophobia," all suggest the alliance with classical neuroses which we do not believe exists directly. It has been suggested that the term "combat fatigue" be applied to the uncomplicated syndrome. This title carries with it no connotation of emotional instability or of future recurrence, and would seem to be the best of names suggested thus far, although actually the fatigue of combat is only one of the several factors involved in the production of symptoms. Those cases which develop complicating symptoms of conversion, anxiety, compulsion, epilepsy, or what not, should be called by their proper diagnostic titles of psychoneurosis (hysteria or other), for that is what they are, and in them

the combat is only an incident. We cannot stress too much that in these complicated cases presenting secondary signs, the treatment, prognosis, and disposition are exactly the same as for the same disability occurring in a peacetime setting, except as they be altered by the secondary gain possible (under the pension system) to any disability occurring during war.

Before entering into a discussion of therapy, the following illustrative cases of combat fatigue, with its complications and differential diagnosis, are presented.

CASE REPORTS

Case 1.—This 24-year-old patient, a boatswain's mate, first class, who had 1 year and 2 months active duty in the United States Naval Reserve was admitted to the hospital for neurological examination when he complained of slight weakness of the left shoulder and was observed to have wasting of the suprascapular muscles.

The patient is a tall handsome young man, the eldest son of a sound middle-class family, which had always been secure financially. Although an indifferent student at a large city high school, he was outstanding athletically as a prominent member of the football, baseball, basketball, and swimming teams. After leaving school he held several positions of a minor nature, though performing satisfactory work, and in addition served 2 years in the United States Navy, receiving a disciplinary discharge in 1940, which he deliberately incurred at his family's urging. The patient subsequently married and is happy at home with his wife and child.

He served on cargo and transport ships in the Pacific prior to the opening of the North African campaign and was twice officially commended for meritorious duty during this period. During his duty in the Atlantic he witnessed a tanker explode and was upset in noticing mangled bodies sweeping past his ship. He was transferred to another ship shortly before the North African invasion. After the original landing on the North African coast the patient injured his shoulder during a fall while diving into a foxhole as the enemy planes strafed the beach. He was then exposed to the sight of his friend who had been mutilated by the loss of his leg during this engagement, and later witnessed the sinking of four transports and the narrow escape of his own ship following a submarine torpedo attack. He returned to this country, continuing on duty at his own request although suffering terrifying nightmares recapitulating his war experiences and becoming unusually alarmed and apprehensive when exposed to previously innocuous sounds. His wife noticed his sensitivity and his unwillingness to attend cinemas that depicted combat scenes but at no time did he consider his symptoms sufficiently severe to necessitate medical aid. They were only elicited by direct questioning during the neurological examination. The patient was found to present atrophy and weakness of the muscles supplied by the suprascapular nerve as well as a costochondral dislocation of the first left rib. He declared that the psychological symptoms mentioned before had become less disturbing and less frequent during the previous 3 months.

Following 4-weeks' treatment for the injury to the shoulder the patient was returned to duty. At no time during the period of hospital observation was he observed as restless, agitated, sleepless, or apprehensive.

Comment.—This previously stable 24-year-old man developed fleeting restlessness, nightmares, and sensitivity to otherwise innocuous sounds following

his exposure to combat. The symptoms were never disabling and had, according to his own statement, subsided in frequency and intensity during the intervening 3 months. This type of mild disturbance rarely arrives in hospital and can be handled easily aboard ship if recognized.

Case 2.—This 18-year-old radioman had 1 year and 3 months service in the United States Navy prior to his admission to the hospital with symptoms of anxiety and depression.

The patient is the youngest son in a happy artisan family of four children. He was the favored child but throughout his early life gave no indication of instability. At school he was an average student and later was president of his high-school class and an outstanding football player. At the outbreak of the war, he enlisted in the naval service with the consent of his parents, and immediately after completing his recruit training was detailed aboard a destroyer where the morale was high. He made many close friends and with personal assistance of the communications officer, who helped him with the radio work, made a rapid advancement in rate.

The destroyer was part of the screen of an aircraft carrier engaged in the Coral Sea Battle, the raid on the Gilbert and Marshall Islands, and later the Battle of Midway. At the onset of each engagement the patient felt apprehensive but once firing commenced he became entirely composed and attentive to his duties. While the destroyer was lying alongside a stricken aircraft carrier following a bombing attack during the Battle of Midway, June 1942, the patient heard the warning of "torpedo wakes." He was then sitting alone in the emergency radio room aft, arose, saw the white wakes approaching the ship, resumed his post until suddenly thrown out of his seat when the torpedo exploded beneath him. He ran from the shack, cut down some life rafts, plunged overboard and swam rapidly away from the ship. As the depth charges of the sinking ship exploded he was dazed and coughed up blood. He reached a nearby raft, which was later evacuated by another destroyer. He was then cognizant that his best friend, his immediate chief, and the communications officer, had all been killed. On being taken aboard the ship he collapsed. Following his return to the naval base, it was learned that he had suffered blast injury to the chest and abdomen which eventually necessitated intestinal resection. During convalescence from this operation he first had terrifying nightmares in which various scenes related to the sinking of the destroyer were continually repeated, and which awakened him in a state of anxiety. Sudden noises also produced unusual apprehension. He felt fatigued and tired, but on his return to the mainland was well enough to request return to duty in spite of the symptoms, and to marry 4 months after the injury. His wife, a young irresponsible girl, resented his desire to remain home, deserted him within the month and was found to be unfaithful. This precipitated a depression with acute anxiety, preoccupation with his combat experiences, his marriage, and worry over pains in the operative scar, loss of appetite and insomnia. An attempt to annul the marriage failed and as he was unable to obtain leave he went A. W. O. L. in order to contact his family and obtain their help. When the patient turned himself in at the receiving station his emotional disturbance was noted and he was transferred to this hospital.

He was admitted to the medical service on January 29, 1943. There was no evidence of physical disease but his insomnia, anorexia, constipation, and fatigue were observed and psychiatric study was requested. The patient was listless, dejected, and emotionally labile. Discussion of his battle experiences was distressing to him and he described in detail his sensitivity to sounds and various combat scenes in motion pictures. The latter stimulus invariably led to anxiety. After 1 month of treatment on the psychiatric service, assistance in correcting

his marital affair, and reassurance concerning the disciplinary measures to be taken against him, improvement was noted. He was more energetic, content, slept well, commenced to eat, gained some weight, and again desired to return to duty. Nightmares were infrequent, he was again able to attend movies and sounds were less disturbing to him. It was possible for him to describe his war experiences without tension. A Board of Medical Survey recommended his return to limited active duty for a period of no less than 6 months following his discharge from the hospital, under the diagnosis of combat fatigue.

Comment.—This previously stable adolescent, with a long period of service aboard a combatant ship, developed catastrophic nightmares, "startle," and fatigue, as well as severe blast injuries to the chest and abdomen, following the torpedoing of his ship. The psychological symptoms were aggravated following his rejection by his wife and were then complicated by depression, anxiety, restlessness, and resulted in his first breach of regulations.

(To be concluded)



MOSQUITOES

There is a justifiable difference of opinion among students as to the most dangerous insect enemies of mankind, but it is easily between the mosquitoes and flies.

There may be harmless mosquitoes, but students of these insects look with suspicion upon all of them. At present, however, of some 1,400 species only two are of immediate importance, the malarial mosquito (*Anopheles*) and the yellow fever mosquito (*Aedes*). These are almost everywhere, even far into the Arctic regions.

Few of us have comprehended the staggering losses caused to humanity by malaria. The monetary loss is exceedingly large—startling in fact—even in these times of huge figures in daily use but it is almost impossible to estimate the loss in life and sickness.

"It is not in its death rate that the great injury from malaria lies; it is in the sickness rate—in the loss of efficiency it causes, rather than in the loss of life. One death from pneumonia ordinarily corresponds to about 125 sick days—work days lost; one death from typhoid fever to 450 to 500 sick days; one from tuberculosis to somewhat more than this among whites. A death from malaria, however, corresponds to from 2,000 to 4,000 sick days. The loss of efficiency may be really doubled or trebled, for the man infected with malaria is frequently half sick all the time. The loss of efficiency caused by malaria in this country, in the malarial sections, is beyond comparison greater than that caused by any other disease, or even by any two or three diseases combined, including typhoid and tuberculosis."

Male mosquitoes do not bite, as they have no equipment for penetrating the skin. The female mosquitoes do not bite, but saw through the skin with neatness and speed. The males are readily recognized by the plumose antennae (beards), which are large and readily seen with the naked eye.

The mosquitoes that cause yellow fever (*Aedes*) also transmit the virus of dengue. Various forms of filariae are also transmitted by mosquitoes, and such cases are quite common in many tropical regions.—Skinner, F. A.: Insects, ticks, and worms in human medicine. Clin. Med. 49: 327-330, Nov. 1942.

BATTLE CASUALTIES ABOARD A LIGHT CRUISER ¹

GERARD B. CREAGH
Commander (MC) U. S. N.

This report covers a period of 6 months during which time the ship, a light cruiser, was actively employed in enemy waters. The casualties, though limited in number as battle casualties go, are representative of the types of injury commonly encountered.

These casualties occurred for the most part in actual combat with the enemy, and all in a combat area. They were highly localized, and occurred in groups small enough to permit adequate handling by the medical department. There was no damage incurred to the sickbay country at any time, which made possible a more careful and deliberate appraisal of organization and treatment, and the employment of certain elective procedures which otherwise might not have been used.

There should be no compromise with accepted methods for handling such injuries. Established principles of treatment, equipment with which the medical officer is familiar, and modern drugs which he thinks he might need should be demanded.

Makeshift or improvised equipment, which may be required in the field, should seldom be found necessary aboard ship. Every refinement in technic and general nursing care should be provided the wounded.

No elective surgery should be done aboard, and the wounded should be prepared for evacuation to places of quiet and safety at the first opportunity.

The following battle casualties were treated aboard the ship during the past 6 months:

1. Burns—13 cases.
2. Injuries, multiple, extreme (gun explosion)—5 cases.
3. Wounds, gunshot (machine-gun bullet)—3 cases.
4. Wounds, gunshot (rifle ball)—2 cases.
5. Wounds, multiple (shell fragmentation)—6 cases.
6. Contusions and sprains (aerial bombing)—5 cases.
7. Wounds, multiple lacerations (aerial bombing)—1 case.
8. Fracture, compound—4 cases.
9. Fracture, simple—2 cases.
10. Dislocation, acromioclavicular joint—1 case.

¹ Received for publication April 15, 1943.

The type injuries will be considered, together with the methods and problems arising in treatment.

BURNS—13 CASES

The burn cases reported include those involving 10 percent or more of the body surface. The clinical observations on these cases are listed in table 1.

TABLE 1.—*Clinical features of 13 burn cases*

Initials and rate	Cause	Degree of primary shock	Area involved	Extent of burn	Days under treatment
L. F. B., Sea. 1c.....	Gun explosion.	Mild.....	Head, face, forearms..	15 percent second degree, 10 percent first degree.	8
F. B., Sea. 1c.....	do.....	None.....	Face, neck, forearms...	4 percent second degree, 8 percent first degree.	7
C. B., Sea. 1c.....	do.....	Mild.....	Face, right arm, forearm, shoulder.	3 percent second degree, 15 percent first degree.	10
K. R. H., T. C. 1c.....	do.....	Severe....	Head, face, both arms, and forearms, chest, lower legs.	10 percent third degree, 20 percent second degree, 10 percent first degree.	(¹)
C. K. H., Sea. 2c.....	do.....	None.....	Face, shoulders.....	3 percent second degree, 7 percent first degree.	5
T. J. M., Sea. 2c.....	do.....	Mild.....	Face, neck, hands.....	3 percent first degree, 9 percent second degree.	7
S. J. F., Sea. 1c.....	do.....	None.....	Both forearms, right hand.	2 percent second degree, 10 percent first degree.	5
W. M. S., Sea. 2c.....	do.....	Mild.....	Face, neck, left forearm.	12 percent first degree.....	6
H. E. T., Sea. 2c.....	do.....	Moderate	Face, neck, both forearms.	5 percent second degree, 10 percent first degree.	20
H. B. W., Sea. 2c.....	do.....	do.....	Head, neck, both hands.	5 percent second degree, 8 percent first degree.	21
E. L. C., Sea. 2c.....	do.....	do.....	Head, face, neck, both forearms and hands.	7 percent second degree, 15 percent first degree.	22
H. R. B., F. 1c.....	Scald, hot sea water.	do.....	Scattered areas (splash) both arms and forearms, abdomen, both thighs.	18 percent second degree, 5 percent third degree.	63
R. A. C., B. M. 1c.....	do.....	do.....	Both arms and forearms, chest, abdomen.	15 percent second degree, 15 percent third degree.	80

¹ Still under treatment (grafting).

Eleven cases resulted from the explosion of a 5-inch, 38-caliber gun, furnishing supporting fire for troop landings against an enemy-held island, and two from scalding.

The general care and treatment was the same in all cases. Of the 11 burns resulting from the explosion, all were of the "flash" type, and included first- and second-degree burns of the head, face, neck, arms, and hands (exposed areas), with sporadic areas of third-degree involvement.

One case, K. R. H., T. C. 1c, was injured in a turret, one gun of which exploded with enough violence to lift the turret's top and face plates, yet the patient showed no evidence of "blast" injury. Four other men in the turret were killed instantly.

Morphine tartrate, grain $\frac{1}{2}$ (Syrette) was given each of these patients, most of them receiving it before arrival at the sickbay. They were immediately put to bed, no effort being made to remove clothing, or to administer any local treatment at the time.

Plasma was administered where needed on the basis of 50 cc. for each percent of body surface involved. An effort was made to give one-third of the estimated amount needed during the first hour, and the remaining two-thirds during the next 10 hours. This meant a constant flow of plasma over this period. Primary shock was effectively controlled in all cases.

Local treatment proceeded later, when ample time and help were available for cleaning up the burned areas and for rigging heat cradles. Sulfadiazine was given orally. Warm water and aerosol were used to clean up the skin and burned areas where much dirt, grease, or oil was present. This was followed with opening of blebs and light debridement.

A triple dye preparation, "Dymixal," after the formula of Aldrich (by weight: Crystal violet, 1.17 percent; brilliant green, 0.77 percent; neutral acriflavine, 0.58 percent), was used locally except on burns of the fingers, face, and genitalia. These areas were covered with a 5-percent sulfathiazole ointment.

No particular difficulty was encountered in using the dye, and it formed an effective eschar.

Most of these cases received burns about the eyes, with singeing of the cilia, and with edema and desquamation of the superficial tissues about the lids. The bulbar conjunctivae in such cases were intensely reddened and injected. Frequent irrigations and turning out of the everted cilia, with some analgesic for the relief of pain was found necessary. Two percent butyn sulfate ointment served effectively for this purpose.

Severe secondary shock developed after 48 hours in the one patient (K. R. H.) who was more severely burned. A marked edema of the arms and legs made venipuncture difficult. He responded favorably, however, to plasma.

This secondary reaction was undoubtedly due to loss of capillary fluids into the tissue spaces with a resultant hemo-concentration and further increased endothelial permeability. The question of how much plasma to give in the treatment of such cases of secondary shock is answered by the following formula of Black (1):

5 minus $\frac{500}{\text{Hb percent}}$ multiplied by 1,000 equals total cc. plasma needed.

A simple method, described by Harkins (2) in 1941 is to give 100 cc. for every point the hematocrit exceeds the normal of 45.

As most ships are equipped only with the Tallqvist color chart for hemoglobin estimations, and values above 100 percent cannot be determined by this method, the following may be used satisfactorily:

Determine the hemoglobin every 6 hours with the Tallqvist chart until the reading of 100 percent is reached. Make red blood count every 3 hours thereafter, doubling the first two figures of the count to determine the hemoglobin. Using Black's formula, the total amount of plasma needed is then calculated.

As the earliest possible opportunity for hospitalization of any of these cases was 7 days, the need for accurate clinical means of determining plasma loss is emphasized.

It was not possible to prepare a 3 percent sulfadiazine solution in an 8 percent crude triethanolamine since the sulfadiazine would not go into solution. The resultant suspended drug did not appear to spray uniformly over the burned area.

Recent limited but favorable experience with microcrystalline sulfathiazole insufflation and pressure dressings, as described by Sharr, Ferguson, and Nova (3), leads us to believe that this should be given extensive trial in the treatment of burns aboard ship.

The microcrystalline sulfathiazole, by virtue of its wider therapeutic range, and the simplicity with which it can be administered through a powder blower should make it an ideal agent in the local treatment of all wounds. It was not available for use in most of the reported cases.

INJURIES, MULTIPLE, EXTREME—5 CASES

All of these injuries resulted from an explosion of the breech of a 5-inch, 38-caliber gun, previously mentioned. Four of these men were killed instantaneously from the combined effect of the blast, burns, and multiple crushing injuries resulting from heavy, flying missiles in the turret.

The fifth, in extreme shock, was removed from the turret still alive, but expired en route to the sickbay.

A sixth man in the turret withstood the blast, though severely burned and shocked. His case was considered under burns.

When this accident occurred the ship was in battle condition with all passageways sealed, and with water and ventilation systems turned off for purposes of damage control. When access was created for the transportation of the wounded, the sickbay country was immediately filled with pungent and irritating smoke fumes. This contingency was ably handled by the damage-control officer, who, after determining that no fires existed, was able to turn on the exhaust blowers and rid the area of the fumes in a few minutes.

The venereal treatment room, which had been previously designated as a morgue, functioned well enough for this purpose. The early removal of the dead from the sight of shipmates is imperative. Numerous other casualties, many severely burned, had occurred during this accident, and engaged all of the medical personnel for several hours.

In the meantime the ship had been subjected to repeated air alarms, and submarine contacts had been reported from time to time. This of course resulted in observance of strict damage-control measures,

leaving us without water and ventilation for most of the day. The reserve fresh water tank and fresh drinking water, previously stored in our refrigerator, was of great comfort to the wounded.

The heat was excessive and unremitting and salt tablets were taken throughout the day by all of our personnel.

The explosion occurred about noon, and by evening the condition of the bodies required immediate attention. Until that time nothing had been done about them.

The preparation for burial consisted in packing loose gauze into several large chest wounds and binding up others to prevent seepage. The bodies were sealed in large canvas sacks, open at one end, and each laid in a Stokes stretcher.

The stretchers, each draped with an ensign, were assembled in a messing compartment, the crew assembled, and the commanding officer held a short burial service. The entire procedure required less than 2 hours, and furnished an efficient yet dignified handling of this unpleasant task. The stretchers were later moved to the fantail, the canvas bags weighted, and under cover of darkness were slid into the sea. The psychic trauma experienced by the crew in such an ordeal is great, and medical officers should give some preliminary thought and planning for such a contingency.

Pathological examination is desirable to determine the exact cause of death in such injuries, but this is usually impossible. Two of our cases had deep penetrating wounds of the chest and neck. One showed no external evidence of violence except for burns. Another had fractures of both thighs. Two had copious, frothy, blood-tinged material exuding from the mouth and nose.

Wounds from shell fragments, machine-gun bullets, and aerial bombing, are grouped as to causative violence and a brief case report of each is made.

WOUND, GUNSHOT (MACHINE-GUN BULLET)—3 CASES

Case 1.—Private, U. S. M. C., received a machine-gun bullet at close range over the body of the left scapula. The wound measured about $\frac{1}{2}$ inch in width at the skin margin and about 8 inches in length. The missile had described a deep furrow through the skin and subcutaneous tissues, and severed some of the fibers of the infraspinatus and trapezius muscles. The spine of the scapula miraculously escaped injury. The wound was irrigated, sprinkled liberally with sulfanilamide crystals, and left open. Sulfadiazine was given orally. The wound healed promptly by secondary union, with a broad scar but with no impairment in the function. The patient was ambulatory after 24 hours.

Case 2.—Lieutenant (jg), U. S. N. R., received a superficial wound in the right rectus abdominis muscle when a machine-gun bullet "spattered" against a splinter shield about a gun director where the patient was stationed. A large hematoma developed in about 1 hour. The wound was thoroughly irrigated, the hematoma evacuated, and several small flakes of metal removed, with no debridement.

Sulfanilamide crystals and a protective dressing were applied. The wound healed promptly. The patient had 9 days on the sick list and was ambulatory throughout this period.

Case 3.—Seaman, second class, U. S. N. R., received a penetrating wound through the calf of the left leg from a fragmented 20-millimeter machine-gun bullet. The fragment passed through the belly of the gastrocnemius muscle, entering the leg from the lateral side, and emerging between this muscle and the soleus on the medial side. The major vessels and nerves were uninjured. The wound tract was thoroughly irrigated with normal saline. No debridement. Sulfanilamide was applied locally at both wounds of entrance and exit. A recent letter reports that the wound is healing rapidly, with patient up and about experiencing occasional pain and some stiffness in the muscle.

WOUNDS, MULTIPLE (SHELL FRAGMENTS)—6 CASES

(All of these wounds occurred in Japanese prisoners)

Case 1.—Superficial wound of the thoracic wall. A fragment of metal entered the thoracic wall just below the clavicle, apparently was deflected by the ribs and emerged in the midaxillary line about the level of the eighth rib. Much debris, consisting of splintered wood, fine fragments of metal and bits of canvas were washed from this wound. Debridement was done under local analgesia. Both wound of entrance and exit were sprinkled with sulfanilamide crystals and an effort was made to insufflate the wound tract with the powder (micro-crystalline powder was not available at the time). There was no apparent intrathoracic injury. The patient's progress was satisfactory until his transfer several days later.

Case 2.—Multiple puncture wounds of the left thigh and groin and of the left arm. Irrigation and conservative debridement, under local analgesia was done with sulfathiazole locally and vaseline gauze dressings. No effort was made to remove several small fragments of metal in the left thigh. A small amount of bleeding continued from the wound in the thigh for 48 hours, but had subsided and the wounds appeared clean when he was transferred soon afterward.

Case 3.—Multiple laceration and puncture wounds in the right arm. Under procaine analgesia the larger and deeper puncture wound was enlarged, much clotted blood and debris removed, hemorrhage controlled, the wound thoroughly irrigated, traumatised tissue excised, and the wounds left open with sulfathiazole instilled. The patient was ambulatory on the following morning.

Case 4.—Deep incised wound at the base of great toe. A thin, sharp piece of metal fragment was removed from this wound. The wound was left open, with sulfathiazole locally.

Cases 5 and 6.—Multiple superficial puncture wounds of arms and chest. Cleaned with aerosol and hot water, dusted with sulfathiazole, and protective dressings applied. Foreign bodies were not removed. All six of these patients had been in the sea for an hour or longer. This did not appear to influence the healing of their wounds, and shock was minimal.

All of these cases were in excellent condition at time of transfer.

WOUND, GUNSHOT (RIFLE BULLET)—2 CASES

Case 1.—First lieutenant, U.S.M.C., a .45-caliber bullet entered the thorax just below the clavicle, pierced the apex of the left lung and emerged through the body of the scapula. This patient stated that aside from a sharp burning

pain, momentarily experienced at the time of the accident, he had little other complaint. A slight cough persisted for 72 hours. Temperature never exceeded 100° F. He was ambulatory throughout.

Both wounds were cleaned and covered with a protective dressing. This patient has since returned to duty with no apparent sequelae.

Case 2.—A Japanese prisoner had received a rifle bullet in his thigh which differed in size and type from any used by our forces. The projectile entered the upper thigh and coursed downward for about 8 inches on the fascia lata. It was removed under local analgesia. There was no debridement of wound of entrance. Sulfathiazole locally.

Most wounds from shell fragments, machine-gun bullets, or aerial bombing, resulting in deep lacerations or penetrations, should not be closed.

If sulfathiazole is "packed" or "dumped" into this type wound, and the wound closed, the powder tends to cake and form into concretions which may act as foreign bodies.

If the wound is left open, however, this caking does not seem to be deleterious to the healing process, and, in fact, may offer some protection to the wound.

Many injuries of this type should be immobilized in a plaster cast. This provides rest, and is reassuring and comforting to the patient, who perhaps may have to be transferred several times before reaching his final destination.

CONTUSIONS AND SPRAINS (AERIAL BOMBING)—5 CASES

Four of these were injured when an armor-piercing bomb struck the side of the ship about 15 yards from where they were stationed. Their injuries consisted of minor sprains and contusions, but all required admission to the sick list for a few days.

Another case, a seaman, first class, U. S. N., received multiple lacerations about the face and lips, and four of his lower front teeth were broken off when he was thrown against a metal stanchion by the same bomb.

The bomb passed through the ship and detonated immediately under the hull with a violent jarring effect, throwing these men against the steel deck.

FRACTURES, COMPOUND—4 CASES

Case 1.—A seaman, second class, U. S. N., received a compound fracture through the middle third of the tibia from a fall during heavy weather at sea. The accident occurred in a potato bin, and there was a possibility that the wound was contaminated with soil. There was no skin loss. Fixed traction at the scene of the accident by means of a Keller-Blake half-ring splint, and morphine given. Under low spinal the wound was enlarged to permit free and thorough irrigation and careful debridement. Reduction was accomplished with some difficulty and required continuous traction for maintenance. This was accomplished by putting the Keller-Blake splint back on the leg, heavily padding the ankle and heel, and

using the standard buckle and web strap arrangement for the traction. This apparatus was left on, the wound reirrigated, and sprinkled liberally with sulfanilamide and closed. No internal fixation was employed. Plaster cast was applied without removing the traction splint. The splint was removed on the following day. The wound healed by primary union in about 10 days. A small pressure sore over the heel was found when the cast was removed some 10 weeks later aboard the hospital ship to which the patient had been transferred, but the fracture was healing satisfactorily.

Case 2.—Seaman second class, U. S. N., had his ankle crushed and mutilated by a revolving structure on a machine-gun mount, which resulted in an avulsion of the head of the astragalus and the lateral malleolus. Extensive loss of skin and soft tissue, with rupture of the peroneal tendons. Treatment: Extensive debridement of pulped and devitalized tissue and removal of bone fragments under spinal anesthesia; instillation of sulfanilamide crystals, with a heavy dressing of vaseline gauze over the entire area; immobilization in plaster cast. This patient was transferred ashore 3 days after the accident, and there has been no opportunity for follow-up of his case. His general condition was excellent at the time of transfer.

Case 3.—Coxswain, U. S. N., received a compound fracture of the first and second metatarsals and phalanges, with disruption of the first metatarsophalangeal joint, when the barrel of a 1.1 mm. machine gun ruptured. Treatment: Under spinal anesthesia the wound was adequately enlarged for thorough irrigation and debridement, fracture reduced, sulfanilamide instilled, wound closed, and immobilized in plaster. This wound healed by primary union. Patient convalescing at present time.

Case 4.—A seaman first class, U. S. N., received a compound fracture through the head of the fibula with a penetrating wound into the knee joint from the rupture of a 1.1 mm. machine-gun barrel. Treatment: Enlargement of the wound, irrigation, and debridement; reduction without internal fixation; sulfanilamide locally; wound closed; immobilization in plaster; local anesthesia. This wound healed by primary union, the cast was removed early and active motion begun in knee. When transferred, patient was progressing satisfactorily.

No drainage was employed in any of these cases, and it was found unnecessary to leave any suture material enclosed in the wound. A window was cut in the cast over the site of the wound in all cases, but subsequent dressings were rarely necessary.

Pontocaine-dextrose solution for spinal anesthesia has been found particularly satisfactory, in that the weighted solution is more mobile, the level can be more easily controlled, and the anesthesia lasts much longer than with procaine crystals. This lengthy anesthesia allows ample time for the application of the cast, and with the small dosage required, the toxicity seems to be less than with procaine.

There has been no necessity for supplementing this type of spinal, but we believe that pentothal sodium, given cautiously and with oxygen at hand, can be safely employed.

Aerosol as a detergent has proven very satisfactory and inexpensive. It was used in cleaning up most of the wounds and the numerous "powder pits" which were present in the victims of the explosion.

Tap water was satisfactorily used in irrigating wounds and obviated the necessity of storing large quantities of sterile water or saline.

Tap water made aboard ship is fresh water distilled in a double-effect, low-pressure evaporator from sea water. This produces water that is practically sterile and free from all salts except sodium chloride, which is present in a concentration of 2 grains to the gallon.

SUMMARY

An experience with battle casualties over a period of 6 months aboard a light cruiser is presented.

The importance of early treatment, both as an immediate lifesaving measure and as an influence on morbidity rates after transfer for hospitalization, is pointed out.

In the treatment of burns, emphasis was placed on early supportive treatment, rest, and the deferment of local treatment until patient had completely recovered from his primary shock. "Triple dye" was used locally but it is believed that microcrystalline sulfathiazole and pressure dressings have some advantage over any of the eschar-forming drugs.

Compound fractures were satisfactorily treated aboard by open reduction, careful but limited debridement, and without internal fixation. Sulfanilamide was used locally with immobilization in plaster cast.

Gunshot wounds were treated by thorough irrigation with warm tap water, conservative or no debridement, sulfathiazole locally, and without closure, and with immobilization with plaster when indicated.

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EXTERNAL TEMPERATURE IN RELATION TO SHOCK THERAPY

The effects of various external temperatures in contact with control and experimentally shocked animals were investigated. Cold and heat proved to be deleterious to the life of animals in shock. An external temperature in the neighborhood of that of the mammalian body seems to be optimal for the survival of shocked animals. These findings justify the conclusion that as long as whatever is lost, whether it is plasma or whole blood, is not replaced, heating or chilling shocked animals is harmful, while keeping them comfortably warm contributes favorably toward their survival.—Wakim, K. G., and Gatch, W. D.: The effect of external temperature on shock. *J. A. M. A.* 121: 903-7, Mar. 20, 1943.

A PROGRAM FOR THE EMERGENCY TREATMENT OF EXTENSIVE BURNS¹

SAMUEL G. BERKOW

Lieutenant Commander (MC) U. S. N. R.

This program contemplates the emergency treatment of burn casualties in considerable numbers, as in a major catastrophe. Actual treatment, under such conditions, must be largely by workmen instructed in first aid, and by hospital corpsmen, directed by a relatively small number of medical officers. The specific requirement is a simple technic, which conserves time and materials, is independent of laboratory aids, and unadorned with nonvital refinements of local therapy.

IMMEDIATE CLASSIFICATION

On arrival at the first-aid station or dispensary, major burns should be differentiated from minor ones. This can be done with minimal exposure of the burned surface. Burns which do not seem to be extensive to casual view, often produce serious results. The extensiveness of burns of the trunk, buttocks, and thighs is particularly apt to be misjudged. The following definition is offered: A minor burn is one which involves 1 percent or less of the patient's body surface; or, more simply, a burn which can be covered by the patient's hand (fig. 1).

Burns involving more than 1 percent and not over 5 percent of the patient's skin area are considered "intermediate." Associated factors (such as excitement, exhaustion—physical and mental—fatigue, exposure) contribute to the state of shock. This is especially true of catastrophe burns and of burns occurring in battle. "Intermediate" burns should be treated as minor or major, according to the patient's condition. We consider all burns involving more than 5 percent of the surface area (that is, more than the area covered by 5 hands), to be major burns. For reasons previously stated, however, our program cannot presuppose clinical judgment. Therefore our outline simply states: "An extensive burn is one which cannot be covered by the patient's hand."

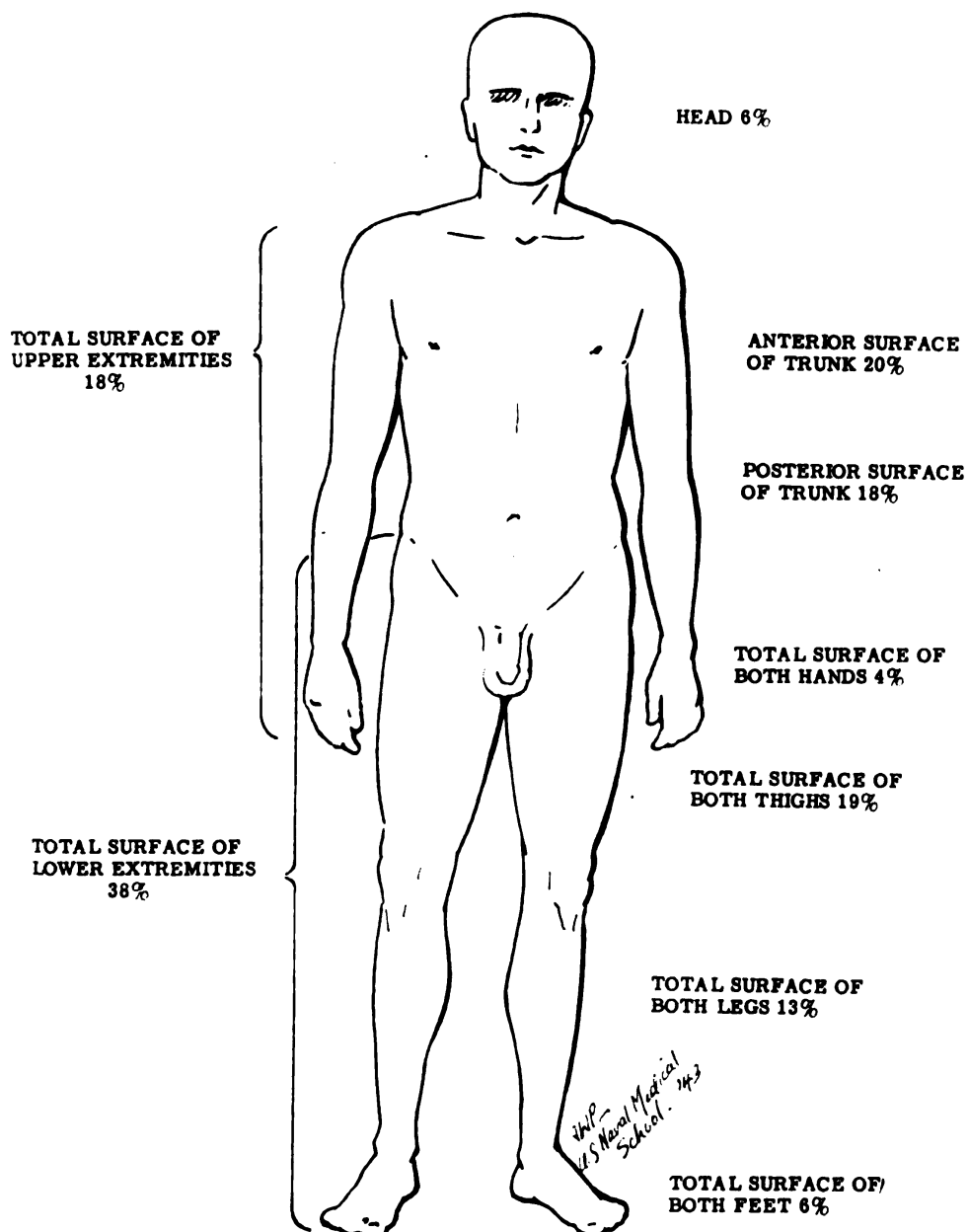
Later, if the patient remains in the first-aid station or dispensary, a more comprehensive evaluation of the extent of the burn will be necessary. For this, the author's method (Berkow formula) is used.

¹ Received for publication February 24, 1943.

ORGANIZATION

What constitutes essential emergency therapy is largely determined by the patient's condition and the length of time he must remain at the first-aid station or emergency room. The latter will vary with the availability of transport facilities. Our plan of emergency treatment

RELATIVE SKIN AREAS ACCORDING TO BERKOW



has been organized to follow this time factor in an orderly sequence.

Three time periods are set up:

1. On admission, treatment is directed to immediate dangers: Pain, respiratory distress, and continuing injury from magnesium, metal or phosphorus. Locally, a nonadherent protective covering is applied.

2. If the patient cannot be transferred to a hospital on completion of the primary treatment, a fixed amount of blood plasma is injected. Supportive treatment, to retard and minimize impending shock, is included in this period. The patient receives no further local therapy at this time.

3. When emergency care must be of still longer duration, plasma requirements are estimated and adequate dosage provided. Burned surfaces are guarded against and treated for contamination and further local fluid loss. The danger of the development of subsequent infection is further combatted by oral sulfonamide therapy.

The advisability of evacuating the patient as soon as transfer to a hospital is practicable is emphasized throughout.

Most elements of this plan of emergency treatment are obvious and require no explanation. Shock therapy, with regard to the sequence of plasma administration, and other measures to retard and diminish circulatory collapse; the details of early and follow-up plasma administration; the nature and rationale of local therapy are of particular concern.

SHOCK

We concur with the opinion that "effective treatment (of shock) depends upon total support of the patient, not merely the application of a single measure of therapy."

Shock, following burns, is generally regarded as divisible into two phases: Immediate or primary shock, for which psychogenic and neurogenic factors are held chiefly responsible; and secondary shock, evidenced later, in which circulatory collapse following the loss of blood plasma is the dominant feature. This distinction is convenient, but cannot be reconciled with the fact that loss of blood plasma from the burned surface begins immediately. The train of events leading to circulatory collapse gets under way at the moment of injury. Pain, fear, and asphyxia can directly induce a reduction of blood flow. In extensive burns, they act with and upon other factors to initiate and accelerate the progress of preclinical (impending) shock. The second set of factors includes plasma loss, hemoconcentration, capillary atony and stasis, tissue anoxia and increased capillary permeability, and still greater extravasation of plasma from the blood stream. These factors have the self-accelerating property of a vicious circle.

An automatic braking mechanism also begins to operate at once. Arteriovenous constriction supports the blood pressure and sustains the circulation. When the state of clinical shock is reached and its earliest features can be recognized, the braking mechanism has failed, the blood pressure falls, and the train of untoward circumstances rapidly arrives at its ultimate destination: The point of complete circulatory collapse and death.

It is self-evident that we should attempt to arrest this progress at its earliest possible stage and continue our attack all along the line by

every possible means. But we must not apply all measures simultaneously. The compensatory mechanism would be injured, and the patient's life would be endangered, by such overenergetic and ill-considered treatment.

Our first concern (first period) is the relief of pain. Syrettes of morphine tartrate in convenient, one-half grain doses are advised. A medical officer should not hesitate to give morphine intravenously when pain is extreme. If Syrettes are not available, a solution of morphine sulfate should be prepared in a beaker or dish, 50 half-grain or 100 quarter-grain tablets dissolved in 50 cc. of sterile water.

Cyanosis and respiratory distress should be treated promptly, by the administration of oxygen through a nasopharyngeal catheter or (preferably) a mask. Extreme difficulty in breathing requires immediate relief. A low tracheotomy should not be delayed. It is the writer's impression that many lives would be saved if physicians were less conservative in this respect. Inhalation of noxious gases, smoke, or superheated air produces edema and exfoliation in the respiratory tract. This is one of the principal factors in early death from burns. First-aid stations should be equipped with the essential materials for oxygen therapy and tracheotomy.

Immediately following these measures, 250 cc. of blood plasma is injected intravenously (second period). Routine orders for a fixed amount of plasma has obvious advantages in the program here considered. A significant reduction of blood plasma occurs in the first hour. Early administration of 250 cc. of plasma will retard impending shock. While we might consider a larger amount indicated, the extent of a large burn catastrophe cannot be foretold, and possible limitations in the amount of plasma immediately available must be considered. We must also give weight to the fact that in the first hour the loss of injected plasma is most rapid. When clinical evidence of shock is present, the plasma required is estimated according to instructions contained under third period, and plasma administration is continued for adequate therapeutic dosage.

While plasma is being injected the patient rests, with feet elevated to promote venous return. Warmth is provided only if the room temperature is below 85° F. The patient is reassured by word and attitude. This should be stressed. It is an important measure for combatting preclinical shock. Water and sweetened hot tea are offered, if the patient can swallow. If he smokes, and has no throat irritation, he is given a cigarette. Smoking has a calming effect on habitual smokers. Also the nicotine produces a prompt, marked vasoconstriction. It has been noted that constriction of the arterioles and venules is the automatic, conservation response of the body to burn injury, whereby blood pressure is elevated and the circulation sustained.

Prolonged stay (third period) at the first-aid station or dispensary requires adequate plasma dosage. At this time, the burned areas are uncovered for definitive treatment. The (relative) extent of the burn is estimated by Berkow's method. (The illustration received from Captain Hook is used, being simpler than the one previously adopted by the author.) Plasma dosage is calculated by the National Research Council's formula, which is a modification of Harkins' original proposal. This allows 100 cc. of plasma for each percent of body surface burned. The patient receives one-half of this amount minus the 250 cc. previously injected. The remainder is given in divided doses, within 24 hours. (This amount is for a person weighing 150 pounds, but no modification for weight is included in these orders. No figures have been published, to our knowledge, to correlate the weight factor.) In most instances, plasma dosage by this formula is probably in excess of actual requirements. It is assumed that by this time additional plasma, if needed, will have been received at the first-aid station, and no deprivation will result if plasma is administered liberally. In all burns involving over 20 percent of the body surface, oxygen therapy is advised.

LOCAL THERAPY

The requirements of ideal emergency local therapy, in the circumstances specified, are both positive and negative.

Positive:

1. Prevent further contamination.
2. Discourage bacterial growth.
3. Lessen plasma loss from the injured surface.
4. Keep the burned surface dry.
5. Require minimum care.
6. Permit rapid evacuation of the patient.

Negative:

1. Remaining islands of epithelium should not be injured by the immediate treatment or upon removal of the dressing.
2. Blood circulation should not be interfered with—especially in burns involving extremities.
3. Immediate treatment should not interfere with the subsequent choice of therapy by those charged with the definitive care of the patient.

Expense is a further factor. An essential requirement not included in the above is that the material selected should be available and not a restricted item. If further quantities of the material can be obtained readily and in adequate quantity from local stores in case of need, this would be distinctly in its favor.

The use of a cellucotton-pad dressing would fulfill all of these requirements except No. 2. This material is already put up in a form

convenient for instant use. It can be obtained from local drug stores and department stores, already packaged, as sanitary napkins.

For use in burns, the gauze wrapper is removed. The pad can be divided readily into two (or more) parts of equal size. It has a tab at either end, which facilitates its application with the least danger of hand contamination. After covering the wound with cellucotton pads in burns involving the extremities the gauze wrapper may be used to secure the pads to the part.

The cellucotton pad protects the burned area from contamination; it soaks up a large amount of plasma, leaving the wound comparatively dry; on taking up fluid, the pad swells and, with the edema of the underlying tissue, becomes a "pressure bandage," and so tends to reduce fluid loss from the burned surface. No special effort is needed to cause pressure. Withal, the pad remains sufficiently resilient not to obstruct blood circulation. Remaining islands of epithelium are not injured by this dressing, nor upon its removal, for the pad disintegrates in water, and can be soaked off readily. It does not interfere with later choice of therapy.

In the first period, exposed raw surfaces are covered with one or more pads, without preliminary treatment. Unnecessary exposure of wounds is avoided. The dressing is secured by gauze bandages or sterile towels or a sheet. However if the wound contains burning particles, it is first covered with water until the particles (molten metal, white phosphorus, or magnesium) are removed with sterile forceps. White phosphorus is found in burns inflicted near the source of a screening smoke (the smoke is harmless, but hot particles of phosphorus fly about and may imbed themselves in the skin). Such burns are covered with a wet dressing of sodium bicarbonate solution. No further local therapy is advised until the third period.

Exposure of the wound should not be rushed. When the patient has recovered from actual or impending shock, and quiet has been restored; when unnecessary traffic and drafts can be avoided, and aseptic precautions are possible, the dressing party and all patients in the room should be masked and the wounds uncovered.

The burned surfaces and then the surrounding skin are irrigated with plain soap solution and boiled water from sterile containers. If it is necessary to remove foreign material still imbedded in the burn, sterile forceps and sterile cotton pledgets are used for this purpose. The wound is not scrubbed. The burned areas are rinsed with sterile saline solution, which is available in pint cans or bottles. The burns are then covered with cellucotton-pad dressings, as previously described.

At this time 60 grains of sulfathiazole are given orally. Sulfathiazole was selected because the danger of pneumonia must be considered

in every extensive burn. But the action of the sulfathiazole is not only systemic; plasma leakage distributes the sulfathiazole on the wound surface in slightly higher concentration than is present in the blood stream. Even as local therapy, therefore, oral (or parenteral) sulfonamide administration has advantages, it seems to us, over dusting or painting the drug on the surface.

Exclusion of immediate local antisepsis simplifies our program and has other advantages. Attention is focused on the treatment of respiratory distress and shock (actual or impending). Minimal exposure of the wounds and protective covering to prevent further contamination are sufficient, if the patient can be transferred to a hospital before the wounds become infected. Definitive local therapy should be left to medical officers in the hospital.

If the emergency treatment is of longer duration (third period), cleansing of the contaminated surfaces should still suffice to prevent infection; oral or parenteral sulfonamide therapy provides a further safeguard. We believe that at this early stage asepsis is feasible and preferable to the local antiseptics available.

Tannic acid and silver nitrate should not be discarded. Rapid tanning is still the best means for diminishing the local fluid loss. Plasma supplies may be insufficient for immediate requirements, and in such circumstances tannic acid therapy is indicated.

In conclusion, we wish to stress the fact that the outline offered herewith was prepared for a specific purpose: To treat a large number of extensive burns occurring in a short period of time; to treat them only until they can be transferred to a hospital, but as long as may be necessary; and bearing in mind that this treatment will be largely by lay personnel who have received first-aid instruction. It is not intended for definitive treatment, but should integrate (and not interfere) with the later treatment.



THE ETIOLOGY AND TREATMENT OF VINCENT'S INFECTION

It is known that one of the principal strains of bacteria inhabiting the dental abscess and the periodontal pocket is *Streptococcus viridans*, a dangerous organism and the chief offender in subacute bacterial endocarditis. Any instrumentation sends showers of these organisms into the blood stream.

Clagett and Smith point out that each dental extraction releases myriads of *S. viridans* into the blood stream. Not only are these organisms released; they are pumped into the blood stream by the luxation of the tooth. This results in a temporary bacteremia, which has been called the "bacterial tide." A previously damaged heart valve is prone to infection during this period. However, the bacteremia invariably disappears after a few minutes. In other words, there is no appreciable effect on the blood stream.—Schluger, S.: The etiology and treatment of Vincent's infection. J. Am. Dent. A. 30: 524-532, April 1, 1943.

THE LATE TREATMENT OF FLASH BURNS¹

WILLIAM W. STRANGE

Commander (MC) U. S. N. R.

and

ARTHUR J. MOUROT

Lieutenant Commander (MC) U. S. N. R.

The large number of cases of burns occurring in this war has lead to an intensive study of the subject and many articles have appeared in the literature. Most of these articles deal with the early treatment of burns, the treatment of shock and fluid loss, and the cleansing and application of various types of dressings to the wounds. There have been few reports on the late treatment of burn cases and the results obtained. The reason for this is that, in the services, the medical officers who first treat the cases seldom have an opportunity to follow them through to recovery. On the other hand the medical officers in hospitals see few early burn cases. Most of their cases are from one to several weeks old and have had various types of treatment before admission. They do, however, have an opportunity to see end results and, therefore, are in a good position to adjudge the relative merits of treatment.

The authors have had an opportunity to see and treat a number of burn cases. Almost all of these cases have had some treatment before admission to the hospital and a great many of them were several weeks advanced when admitted. We believe that the type of treatment employed in these late cases deserves more consideration than has been given, and we have developed decided opinions about some of the advantages and dangers of early methods of treatment.

Knowing that many of the casualties from the recent landing in Africa would be "burn" cases, a special "burn" ward was prepared and ready when the cases were admitted. As advocated by Whipple, only nurses and corpsmen especially interested in burns were assigned for duty in this ward. The complement of personnel had to be well above the usual number assigned to a ward of this size, as burn cases require an extra amount of nursing care. The nurses and corpsmen had received instructions in the treatment of burns and in sterile technic. Through conferences with officers in charge of the clinical laboratory, definite laboratory routines had been prearranged.

¹This paper was written prior to the Bureau of Medicine and Surgery directive of January 21, 1943.

When admitted to the ward each case received a complete physical examination. All dressings were removed and the type of treatment for each case determined. A blood Kahn, urine examination, red blood count, and hemoglobin determination were completed upon each patient shortly after admission. Other laboratory procedures required specific orders for their fulfillment. All these cases had received some type of tannic acid treatment primarily, but in many the eschar had been removed and sulfathiazole ointment applied with or without compression.

The most seriously ill patients were those that still had tannic acid eschars present. All of these had elevated temperatures due to infection beneath the eschar. These tannic acid eschars were easily removed because of the underlying pus and slough. Cultures of this pus showed staphylococcus aureus. To clear up these infected areas, wet dressings of boric acid solution were tried but these proved irritating. Bullova's method, using wet dressings of Pickrell's solution, also proved unsatisfactory; wet dressings of 2-percent acetic acid were then applied, which cleared up most of the infections within 48 hours.

After the infection had subsided, and in those cases that had not become infected, treatment consisted of the application of No. 44-mesh gauze impregnated with 6-percent sulfanilamide in equal quantities of cold cream and lanolin. Over this was placed sterile gauze which had been made up into rolls $2\frac{1}{2}$ yards long, 4 inches wide, and 8 layers thick. Pressure was maintained by elastic bandages. Dressings were changed after 10 to 14 days and most of the burns were found to be completely healed. If the patient developed a temperature, the compression dressings were removed and wet dressings of 2-percent acetic acid applied. Adequate doses of sulfathiazole were also given by mouth. When the infection subsided compression dressings were re-applied. At all times sterile technic was used in changing dressings. One surgeon removed the dirty dressings, and another applied clean dressings. The doctors, nurses, corpsmen, visitors, and in some cases, the patients wore surgical caps and masks. On the face, the sulfanilamide gauze was applied but no pressure could be maintained. No reaction from the sulfanilamide gauze was seen and the blood level of the drug was never above 3 mg. per 100 cc. of blood unless additional doses of the drug had been given by mouth. We did not splint any joints, as we felt that early motion was more desirable. Our results and those of the British confirmed this opinion.

Even after complete healing, the new skin was extremely sensitive. This tenderness was relieved by the application of 50-percent cod liver oil ointment which also kept the skin soft and pliable. At the present time we are trying to decrease the redness of recently healed burns by irradiation of the area with ultraviolet rays after the application of

the cod liver oil ointment. Early results of this treatment are encouraging, but sufficient cases have not been treated to give conclusive data.

Fox, Eckert, and Mader, and others have reported on the areas of the body burned by exploding bombs or torpedoes. Although all the face is usually burned, the tip of the nose, the areas around the eyes, the lips, and the upper portions of the ears seem to receive the more severe



1. THE RESULTS OF A FLASH BURN OF THE FACE. NOTE THE DESTRUCTION OF THE TIP OF THE NOSE AND THE EAR.

lesions. In no case in this group was the cornea injured. Curiously, several cases were burned over the occipital region of the scalp (fig. 2). None of the patients were able to explain how this area was burned. It is probable that the force of the explosion knocked them down and the scalp was burned by contact with the hot deck or bulkhead. All the patients had second- and third-degree burns of the hands, wrists, and ankles. The terrific heat generated by an exploding bomb or torpedo is of short duration and does not ignite the clothing. Only ex-

posed surfaces of the body are burned. Using Berkow's index, the extent of the second- and third-degree burns in this group of cases ranged from 10 to 50 percent of the body surface.

The burns of the ear were difficult to treat as they were all infected and third degree in severity. The burn area did not extend into the canal but when wet dressings were placed over the pinna and a bandage applied the pus ran down into the canal, setting up a mild inflammation. It was found best to leave the ears open, apply only sulfanilamide gauze lightly about the pinna and allow any pus or secretion to run out into a sterile towel covering the head pillow. When the infection subsided, the raw surface was covered with microcrystals of sulfathiazole.



2. TYPICAL BURNED AREA OVER THE OCCIPITAL REGION DUE TO CONTACT WITH THE HOT DECK.

All of the seriously ill patients had moderately severe anemias, with the red blood count between $2\frac{1}{2}$ and 3 million red blood cells and a volume index of 22 to 28 percent. Accompanying the anemia, these patients also had hypoproteinemia (4 to 5 percent serum protein). In spite of repeated transfusions of whole blood it was difficult to raise the red blood count above $3\frac{1}{2}$ million cells. In one patient the red blood count fell from nearly 4 million to less than $2\frac{1}{2}$ million red cells in 4 days. This drop in the red blood count developed in spite of the patient receiving adequate doses of ferrous sulfate, parenteral liver extract, multiple vitamins and a high-protein diet. Stool examinations were negative for gross blood, although the patient had signs

and symptoms suggesting a Curling's ulcer. This anemia is probably due to increased fragility of the red blood cells, although no hemoglobinuria or clinical jaundice was observed. The anemia was not due to gross hemorrhage. Smears taken from burned area revealed some red blood cells but not enough to explain this severe and rapidly developing anemia. Bone marrow studies were not done but might throw light on the problem.

We believe that skin grafting should be done as soon as a clean granulating surface is present. This is usually obtained in 10 to 14 days after the initial injury, but many times this procedure must be delayed because of infection or the poor condition of the patient.



4. SECOND- AND THIRD-DEGREE BURNS OF THE FOOT, ANKLE, AND LEG WHICH HAD BEEN TREATED WITH TANNIC ACID. ESCHAR HAS BEEN REMOVED.



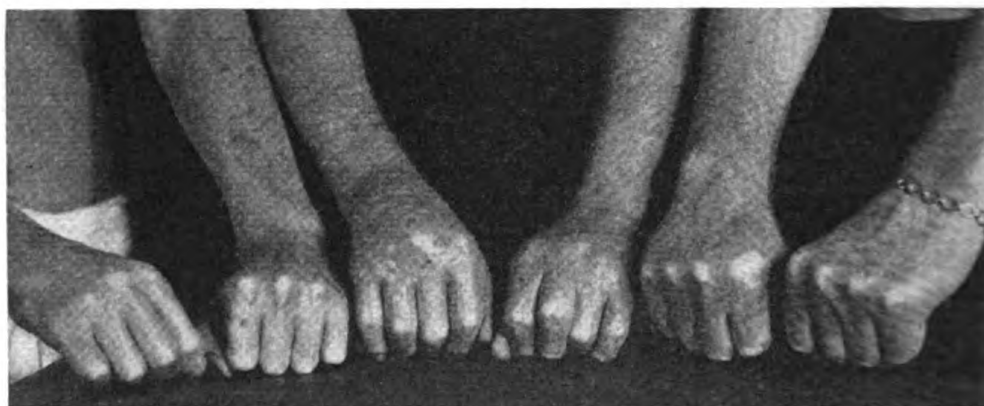
3. HEALED FLASH BURNS OF THE FACE, EARS, NECK, AND UPPER EXTREMITIES. THIS PATIENT WAS WEARING A SHIRT OPEN AT THE NECK AND HAD HIS SLEEVES ROLLED UP WHEN HIS SHIP WAS TORPEDOED.

Grafting is seldom necessary except in third-degree or deep second-degree burns. It is beyond the scope of this paper to discuss the various technics used in skin grafting or in plastic reconstruction.

In the seriously ill burn cases the appetite fails completely. These are the very cases that require a high pro-

tein, high caloric diet but it is difficult to get the patient to eat. The food must be hot, daintily served, and the whims of the patient indulged. Frequent and small feedings are often advisable. Fecal impaction is a minor complication which was seen several times in the present series of cases.

From firm believers in the use of tannic acid, the authors have turned to other methods of treatment. In treating large numbers of burn casualties tannic acid is probably the easiest to apply, but this method of treatment gives very unsatisfactory end results unless a sharp look-out is maintained for infection. Under battle conditions asepsis is seldom possible, and in the great majority of cases infection will develop beneath the eschar. The greater the number of casualties, the less is it possible to give each injured patient adequate attention. In large hospitals, or aboard hospital ships, as Eckert has reported, excellent results can be obtained by using tannic acid but conditions in these



5. FUNCTIONAL RESULTS OBTAINED IN SECOND- AND THIRD-DEGREE BURNS OF THE HANDS.

locations are ideal for any type of treatment. In the hands of inexperienced physicians or where sufficient care and attention is not available, tannic acid can be more dangerous than the burn itself. A short résumé of two cases will illustrate these conclusions.

CASE REPORTS

Case 1.—F. C., aged 24, admitted to the hospital 20 days after receiving second- and third-degree flash burns of the face, ears, upper extremities from axillae to fingertips, back, ankles, and feet (20 percent by Berkow's index). His temperature was 104.4° F. Both upper extremities were covered with a heavy tannic acid eschar beneath which was a pool of pus and slough. When the tannic acid eschar was removed, most of the bones of the phalanges and the metacarpals were visible on the dorsum of the hands. All the extensor tendons had sloughed and the fingers were held in flexion. It is probable that this patient will lose most of his fingers and both thumbs.

Case 2.—C. T., aged 20, admitted to this hospital 3 days after receiving a second-degree burn of the lower left leg, ankle, and foot. On admission, the burned area was covered by a firm tannic acid eschar. The entire leg was swollen, tender, and painful. He said that "it feels as if there is a tight band about my ankle and my

toes have gone to sleep." The dorsalis pedis artery was not palpable. Under general anesthesia the eschar over the instep was cut away. Just proximal to the fourth and fifth toes on the dorsum of the foot was an area of early gangrene. There is no doubt that amputation of the foot would have been necessary if the tannic acid eschar had been allowed to remain 24 hours longer.

The authors have seen relatively few cases of early burns, but the treatment outlined below has given excellent results in those seen. On admission, if the patient is not in shock, his clothing is removed and he is placed in a large bathtub containing hot normal saline solution. This is prepared by adding 2½ pounds of salt to 60 gallons of water. The use of the saline decreases the loss of plasma. Any oil or grease is removed with ether or a detergent. The burned area is gently washed, using soft cotton pledgets and white soap. Washcloths, brushes, green soap and scrubbing are definitely contraindicated. Debridement is performed as gently as possible by a surgeon, using sterile technic. All blisters and loose shreds of skin are carefully removed with sterile forceps and scissors. When the debridement is finished, the patient is placed on a sterile sheet and dried. The sulfanilamide gauze and compression dressings are then applied. Plasma is given if the volume index of the blood is above 50 percent. We give 100 cc. of plasma for every percentage point above 50. Morphine is given as required but is seldom necessary after the dressings have been applied. These dressings are not disturbed for 10 to 14 days unless the patient develops a fever. If the patient is in shock when admitted he is placed on a sterile sheet, beneath a burn cradle, and plasma is administered. No local treatment is attempted until the patient is out of shock. Sulfa drugs are given either by mouth or intravenously to combat infection.

At the present time there is no one accepted method by which burns can be treated. The purposes of a dressing in the treatment of burns are:

1. To protect the burned area from contamination.
2. To be bacteriostatic.
3. To prevent the loss of fluids and plasma.
4. To relieve pain.

The dressings should be easily applied and readily available, be nontoxic and nonconstricting, and should give as good cosmetic results as possible.

The authors feel that the above method, as first described by Evans, attains all of these objectives. Under battle conditions, the sulfanilamide ointment can be applied directly to the burned area, covered with fine-mesh gauze (3-inch bandage is satisfactory) and this covered with a large battle dressing. Two of these dressings will cover most of an extremity, and the muslin tails attached to the dressing can be used as a bandage to secure compression. Additional sulfanilamide should be given by mouth.

CONCLUSIONS

1. Burn casualties are best treated on a special "burn" ward with specially trained personnel in attendance. One general surgeon, one plastic surgeon, a physiotherapist and a laboratory technician should be assigned to each such ward.

2. A dressing of 6 percent sulfanilamide in equal quantities of cold cream and lanolin on No. 44 mesh gauze and compression maintained with elastic bandages fulfills all of the objectives of a burn dressing.

3. The use of tannic acid preparations should be strictly prohibited on the face, hands, feet, and genitalia. Their use on other parts of the body should be permitted only when strict supervision is possible.

4. Early joint movement is superior to splinting.

5. Skin grafting should be done as soon as possible—10 to 14 days after the initial injury.

6. The cause of the severe anemia seen in burn cases has not been adequately explained. Further research, including bone marrow studies, is indicated.

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NO GASTRIC EFFECTS FROM ASPIRIN

Acetylsalicylic acid (aspirin) does not produce hyperemia or cause hemorrhages in the gastric mucosa, nor does it cause any gastroscopically demonstrable changes in the stomach when given in doses as high as 80 grains per day.

The ingestion of acetylsalicylic acid over long periods of time does not produce chronic gastritis. The epigastric distress which sometimes occurs after the ingestion of acetylsalicylic acid might be the result of increased acid production and pylorospasm.—Paul, W. D.: The effect of acetylsalicylic acid (aspirin) on the gastric mucosa. *J. Iowa Med. Soc.* 33: 155-158, April 1943.

100 CONSECUTIVE CASES OF CEREBROSPINAL FEVER AT CAMP ENDICOTT¹

MICHAEL TARANTO
Lieutenant (MC) U. S. N. R.

This short paper is an attempt to relate our experiences with this most fulminating disease. Our cases were admitted to the station dispensary over a period of approximately 2½ winter months. The material was derived entirely from enlisted naval construction battalion personnel, coming from every part of the country and all possible walks of life. While at this New England training center the men were housed in the conventional two-story barracks and bedded in double-deckers. The age range of the group treated was between 18 and 46 years, the average age being 27 years. The bulk of cases were in the 25–30-year-old group.

The clinical manifestations of meningitis which were present on admission, in their order of frequency, were:

1. Headache (90 percent).
2. Nuchal rigidity (80 percent).
3. Vomiting (64 percent).
4. Petechiae (64 percent).
5. Prostration, delirium, or coma (38 percent).

We were particularly impressed with the paucity of neurological findings such as pupillary changes, oculomotor palsies, deep reflex inequalities or paralyses; a positive Babinski was elicited in only 5 percent of this series.

In only eight instances was the laboratory unable to substantiate our clinical diagnosis with the presence of one or more of the following:

1. Increased spinal fluid cell count.
2. Isolation of the meningococcus by direct smear of the spinal fluid.
3. Positive blood culture.
4. Positive spinal fluid culture.

At no time was it necessary to repeat the initial diagnostic lumbar puncture, which was performed as soon after admission as possible.

¹ Received for publication March 13, 1948.

Of the 100 cases, 12 were treated with sulfanilamide, 2 with sulfathiazole, and 86 with sulfadiazine. Five of these patients received meningococcus antitoxin in addition to the sulfonamide therapy. Inasmuch as the overwhelming majority of our cases were treated with sulfadiazine, and there being little difference so far as the dosage of the other drugs utilized is concerned, the treatment as outlined below will be essentially applicable to sulfadiazine.

The mildly or moderately ill patients were given on admission 4 gm. orally; a 2-gm. dose was given in 3 hours, and a similar dose of 2 gm. was given 3 hours thereafter. They then received 1 gm. every 4 hours until the temperature remained normal for a period of 72 hours; and then the dosage was cut down to 1 gm. 3 times daily. If, however, the patient was delirious, comatose, critically ill, or unable to tolerate the drug by mouth, sodium sulfadiazine was administered intravenously in 5 percent concentration in sterile distilled water. Without exception, our initial dose by this route was 5 gm. Only rarely did the patient fail to rally sufficiently in approximately 6 hours to permit institution of the above-mentioned routine of 1 gm. every 4 hours. In more obstinate cases, the drug was repeated by the intravenous route in 8 hours. The total average period of active treatment in this series, during which medication was given, was 8 days; and the total average sulfadiazine intake during this same period was 34 gm.

During sulfonamide therapy a blood level determination was done at the end of the first 24 hours of therapy and repeated on the third day thereafter. Our levels ranged between 7 and 43 mg. percent, the average being 17.8 mg. percent. This was done in conjunction with a hemoglobin estimation and leukocyte examination. Daily routine urinalysis proved very helpful, particularly the specific gravity determination and microscopic study. Every attempt was made to keep the specific gravity below 1.015, by adequate fluid intake, either orally or by the intravenous administration of hypertonic dextrose in physiological saline; this was especially true with the older patients in whom a diminished kidney function was not uncommon, and therefore, adequate intake of fluids most essential. The presence of a small to moderate number of red blood cells in the microscopic study of the urine during active treatment did not prompt our discontinuance of the drug, but if the report of the presence of a large number of blood cells or gross hematuria was received, the dosage was immediately lowered. In one instance of gross hematuria, while under treatment with sulfadiazine, the drug was changed over to sulfanilamide and the urine cleared promptly.

General supportive treatment should be used very freely when indicated. In only 1 case was a whole blood transfusion necessary to overcome anemia, and that case was one complicated by a purulent meningococcic arthritis of the left knee joint. The intravenous admin-

istration of fluids proved very effective in the maintenance of proper fluid and alkali balance, particularly in those cases of persistent vomiting. For those markedly restless or delirious, sedation was of paramount importance, and, in my opinion, should be thorough. The sedative of choice was sodium amytal given intravenously in 1-gm. dosage, repeated as often as necessary. One case necessitated 1.5 gm. initially, to obtain the desired effect. As soon as treatment with sulfadiazine was discontinued, the patients were given thiamine chloride (5 mg.) and ferrous sulfate (3 gr.) three times daily. The average patient was discharged 17 days after the onset of his illness and placed on a 2-week "no duty" status.

The most serious toxic effect of sulfadiazine, with which we had to deal, was gross hematuria in 3 percent of the cases, and at the time of this writing all these have completely recovered. Interesting enough, all were in the higher age bracket. One man had several moderately severe (200–300 cc.) gastric hemorrhages while under treatment with sulfanilamide; but as soon as sulfadiazine was substituted, bleeding stopped.

The chief complication which we encountered was arthritis of one or more joints. This was seen in 12 percent of the series. The joints most commonly involved, in order of frequency, were the knees, hips, elbows, and shoulders. The joint complications presented the typical clinical picture of any acute septic arthritis. Two knee aspirations were done and 4 to 6 ounces of seropurulent material was obtained which, when smeared directly, revealed the presence of meningococci. By using conservative measures such as immobilization and heat during the acute phase, and insistence on early active motion as soon as the acute phase subsided, all our arthritics cleared up entirely with one exception, and in his case, insufficient time has elapsed to warrant the giving of a poor prognosis. During convalescence, backache was complained of not infrequently. Permanent eighth nerve unilateral deafness was encountered in only one instance. The one case which failed to respond to treatment, clinically presented the picture of the Waterhouse-Friderichsen syndrome with circulatory collapse, hemorrhagic rash, cyanosis, and coma on admission to our ward. In spite of prompt and vigorous treatment, the patient succumbed within 24 hours after first being seen by us.

Two cases typical of our series will be given in greater detail better to clarify our treatment.

CASE REPORTS

CASE I

History.—R. L. S., seaman, second class, age 27 years, was admitted to the dispensary on January 3, 1943, at 1900, with a history

of general malaise, chilly sensations, sore throat, and anorexia for 3 days prior to admission, and complaining of a violent, generalized headache. The admitting corpsman stated that the patient vomited while being transported in ambulance.

Physical examination.—Examination revealed a well developed, young adult male, lying quietly in bed, with eyes closed, and acutely ill. His color was a pale, ashen green. His lower thorax and upper abdominal wall presented many pinkish, macular petechiae. Pupils were equal, regular, and reacted to light and accommodation. Nuchal rigidity was 3 plus. No Brudzinski elicited. Temperature 101° F., pulse 100, respiration 22. No other abnormalities were noted.

Laboratory findings.—A lumbar puncture was performed immediately. The fluid was under slightly increased pressure, and was opalescent. Laboratory examination of fluid revealed the presence of numerous gram-negative intracellular diplococci, and the count was 350 white blood cells per cu. mm. (Differential smears were not done.) Routine blood study showed 22,500 WBC with 90 percent neutrophils.

Treatment.—Oral sulfadiazine therapy was instituted at 2000 as follows: Gm. 2 stat., gm. 1 at 2300, and gm. 1 at 0200. Starting at 0600, a 1-gm. dose was given every 4 hours (around the clock), for a period of 4 full days. On the morning of the 6th day of hospitalization, the sulfadiazine dosage was cut to 1 gm. three times daily for a period of 4 more days; and then medication was stopped altogether. Eight days after admission, this patient was free of any clinical evidence of meningitis. On January 20, he was discharged to a 2-week "no duty" status.

CASE II

History.—H. C. B, chief petty officer, age 38 years, was admitted to the dispensary on February 4, 1943, at 0400, with history of having been ill for 2 days outside the station, treated by a civilian physician.

Physical examination.—Examination revealed a well-developed, adult male in a highly delirious, semiconscious state. Restraints were necessary to keep him in bed. Color was ashen. Neck rigidity was 4 plus. Pupils reacted to light. No petechiae present. Temperature 101° F., pulse 100, respirations 24 per minute.

Laboratory findings.—White blood count was 30,400 with 90 percent neutrophils and 10 percent lymphocytes. Spinal fluid count was 25,000 per cu. mm., and smear revealed numerous gram-negative intracellular diplococci.

Treatment.—Because of the extreme violence of this patient, 1 gm. of sodium amytal was given intravenously as soon as the diagnosis was established, and when restlessness ceased, he was given 5 gm. sodium sulfadiazine by the intravenous route at 0800. He received

20,000 units of meningococcus antitoxin intramuscularly at 1600. By 1800 he had reacted sufficiently to permit giving oral medication, and thereupon received 4 gm. of sulfadiazine. This was retained. At 2400 he received an additional 2 gm. A blood level determination done on the morning of February 5, yielded a result of 16.85 mg. per 100 cc. Commencing at 0400 on February 5, oral treatment was instituted (1 gm. every 4 hours, around the clock), until February 10; then the dosage was cut down to 1 gm. four times daily, until it was discontinued on February 14. He was discharged to a 2-week "no duty" status, on February 19.

SUMMARY

1. In the series of 100 consecutive cases of meningococcic meningitis treated at Camp Endicott, the mortality was 1 percent. As far as we are able to ascertain, this low figure is unprecedented in the treatment of this disease.

2. There appeared to be a very definite relationship between the incidence of meningitis, and cold, inclement weather. With onset of warmer weather, and the increase in the amount of daily sunshine, the epidemic gradually but definitely subsided.

3. Incoming, raw recruits were most susceptible to the disease. With the arrival of a new battalion of men, the incidence of sickness began to increase, reached its peak in about 3 weeks, and then declined gradually.

4. The value of sulfadiazine in the treatment of cerebrospinal fever was inestimable, because of the ease with which it may be administered, its relative nontoxicity and prompt therapeutic action, and finally, its ability to cut down appreciably on the incidence of new cases and complications.



THE DENTAL OFFICE AND UNIT AS AN AUXILIARY SURGERY

Facilities immediately and permanently at hand in the dental office are: Sterilizer, operating light, running water, x-ray, diagnostic lamps, suction apparatus, compressed air, cautery, instrument tray, and cabinet top (table).

Simple adjustment of the dental chair affords three or four points of support in the horizontal position, with variations possible in height and tilt. A rimmed table top of plywood is easily constructed aboard. Headed screw eyes at the under corners of the table top permits security by lines lashed as needed. Table top of size to fit a standard sickbay mattress is convenient and affords a hard or soft surface, whichever is more suitable to a given case. A rubber sheet guttered to drain into a bucket is easily arranged when necessary.—Jones, R. H., Lieut. (DC) U. S. N. R., and Millsbaugh, J. A., Lt. Com. (MC) U. S. N.

A SUMMARY OF 50 CASES OF CEREBROSPINAL FEVER, MENINGOCOCCIC¹

WILLIAM NEWCOMER
Lieutenant (MC) U. S. N. R.

and

EUGENE M. FRAME
Lieutenant, junior grade (MC) U. S. N.

In the period from December 16, 1942 to March 6, 1943, there were 50 cases of meningococcic cerebrospinal fever admitted to the contagious ward of the Norfolk Naval Hospital, Portsmouth, Va. This paper is an attempt to summarize and correlate the features of these cases with reference to mode of onset, physical findings, treatment, clinical course, complications, and laboratory studies.

There were two fatalities in this series and brief résumés of the clinical features and autopsy findings are included.

Thirty-one of these patients were referred from one station. Forty cases came in with an established or suspected diagnosis of cerebrospinal fever. The remainder of the diagnoses were varied, including pneumonia, catarrhal fever, arthritis acute, psychosis unclassified, encephalitis lethargica, cerebral hemorrhage, nephritis acute, medical observations, and renal colic.

Approximately 20 cases, not included in this series, were referred with an established or suspected diagnosis of meningitis which were changed to catarrhal fever, acute.

MODE OF ONSET

The modes of onset in this series followed, for the most part, the typical textbook picture, i. e., an upper respiratory infection of 3 to 6 days' duration, followed abruptly by chills, fever, headache, stiff neck, nausea, vomiting, photophobia, delirium, and often coma. Some interesting deviations from the typical were observed.

One patient had never reported to sickbay and was found in the head unconscious with vomitus on his clothing. He was referred with a diagnosis of cerebral hemorrhage.

Another patient had been treated for 7 days for catarrhal fever and "a complicating acute arthritis." He failed to improve and was referred here. On February 5, 1943, he walked into the admitting unit

¹ Received for publication April 12, 1943.

and 1 hour later was found to have a spinal fluid cell count of 4,700, and a positive smear for meningococci.

Another patient had had a cold for 14 days prior to admission and then developed dizziness and difficulty in speaking. He was referred with the diagnosis of acute nephritis.

In 22 of the 50 cases there was a definite history of a cold preceding the more severe train of symptoms. The remainder of the group had somewhat varied complaints; however all included general malaise, chills, fever, headache, nausea, vomiting, and stiff neck. Severe headache was present in every case except the one (nephritis, acute) described above. Twenty-seven of the cases definitely had severe episodes of nausea and vomiting.

PHYSICAL FINDINGS

Collectively this group exhibited the whole gamut of physical findings characterized by increased intracranial pressure and meningeal irritation. However there was appreciable variation from case to case.

Nuchal rigidity was the only objective finding present in all cases. It was described either as increased resistance or definite rigidity, and there was no hedging or doubt shown by any examiner as to its presence.

Six cases were admitted in deep coma and could not be aroused. Fifteen cases were found to be alert and well oriented upon admission. The remainder of the cases of the series were described as being lethargic, apathetic, semicomatose, delirious, or slow to respond. Twenty-nine of the 50 fell into this group.

Seventeen cases were found to have petechiae upon admission, while a large percentage of the remainder developed petechiae at later dates, but the actual number is not available. Five cases in this series showed purpuric macules. It is interesting to note here that the two fatal cases fell into this group, and these two cases showed a very extensive and widespread purpuric reaction. The remaining three had appreciably less capillary hemorrhage, confined to dependent portions.

Thirty-eight of the 50 cases had positive Kernig and Brudzinski signs. Fifteen had hyperactive deep tendon reflexes. The presence or absence of the superficial reflexes was not recorded on all charts; however a cursory review showed these reflexes to be present more often than absent.

TREATMENT

In all but one case in this series cloudy fluid was obtained upon the initial spinal tap. Treatment was then instituted irrespective of laboratory findings.

Each received intravenously 4 gm. of sodium sulfapyridine dissolved in 80 cc. of sterile distilled water. This was repeated usually every 4 hours for 4 doses making a total of 16 gm. in the first 12 hours. It was subsequently administered with regard to the concentration of the drug in the spinal fluid. An effort was made to keep the fluid level at about 10–12 mg. percent during the acute stage.

Parenteral fluid was given, the amount of which was governed by the degree of dehydration. The average was 4,000 cc. daily, of 5 percent dextrose in saline or distilled water.

During the acute stages a daily spinal tap was done and from 20 to 30 cc. of fluid were removed, to approximate a normal pressure.

Morphine sulfate in doses of $\frac{1}{4}$ -gr. was given for restlessness. If the patient was wild and unmanageable he was given pentothal sodium intravenously in doses up to 1 gm. Paraldehyde was given for delirium. No untoward effects or complications were observed from the use of these sedative agents, save 1 case of respiratory arrest seen after the administration of 0.75 gm. of pentothal sodium. This, however, responded to artificial respiration. It should be stated that in all cases sedation was given in sufficient amounts to mitigate the use of restraints.

After the acute stage, sulfapyridine was given by mouth in 1-gm. doses every 4 hours day and night. This was usually continued until the temperature was normal and the patient asymptomatic. The drug used in this series, sulfapyridine, was chosen for intravenous medication because of its low cost, ready availability, and high concentration in the spinal fluid. Frequent catheterization was often necessary, because of the patient's inability to void.

CLINICAL COURSE

A review of the clinical courses of these cases followed a more stereotyped pattern than any other feature of the study.

The temperatures upon admission were practically all between 103° and 105° F. and almost without exception, the fever would drop to between 99° and 100.5° F. within 24 hours. Six patients were afebrile within 4 days. The remainder ran a low-grade fever in a range from 99° to 100° F. for from 8 to 20 days. The whole series, with the exception of the two fatalities, were oriented and rational within 6 days. A large number reacted in from 12 to 24 hours. There usually were no complaints of a specific nature except those relative to drug administration after the 4th or 5th day.

COMPLICATIONS

Serious complications in this series are conspicuous by their absence. Twenty-six cases of the 48 developed rather severe herpes labialis.

One patient developed pulmonary edema on the third day after admission which was thought to be due to too rapid administration of intravenous fluid. This resolved after discontinuance of intravenous therapy. This same patient developed a complete speech aphasia on the 7th day after admission, which cleared up in 9 days without treatment.

There were a number of minor hearing disturbances, such as impairment and tinnitus which cleared up without treatment.

Three patients developed acute septic arthritis, two of the left knee and one of the right, which was thought to be meningococcic. These complications responded to needle aspiration and routine treatment. One patient developed chickenpox on his 12th hospital day.

Nausea and vomiting were almost universally present during and after the administration of intravenous sodium sulfapyridine. Four patients developed a drug rash after the acute phase had been passed; however no toxic reactions were observed which necessitated the discontinuance of the drug during the critical stages.

Hematuria in varying degrees was present in seven patients. All of these patients had reached the stage in their convalescence where they were able to take oral medication.

One patient failed to become oriented, although he showed complete recovery with regard to his infection. He was transferred to the neuropsychiatric service.

LABORATORY

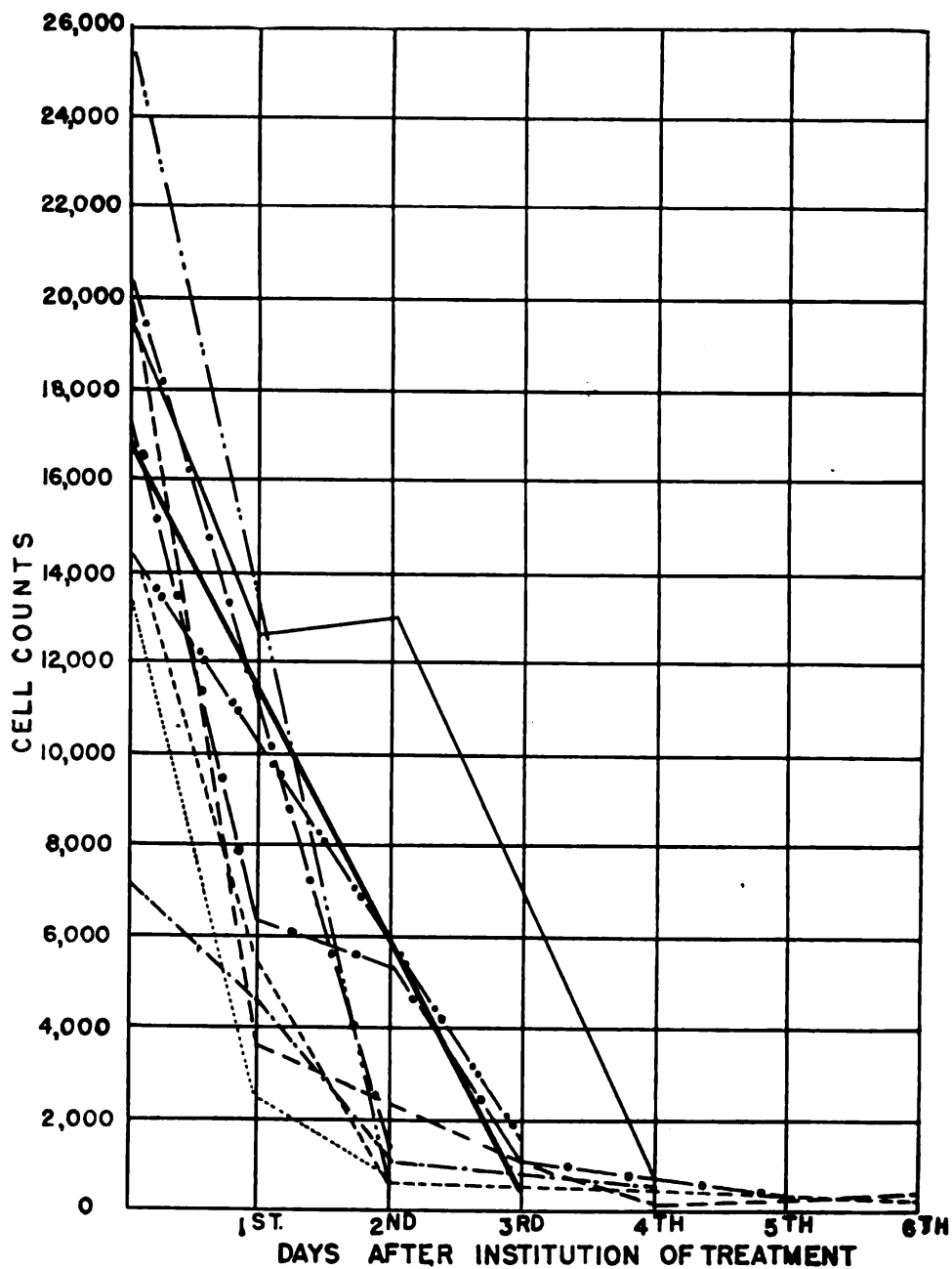
Urinalyses were not remarkable. Sugar was found in two specimens and albumin was present in four upon admission.

All patients showed leukocytosis. The highest count recorded was 50,000 while the lowest was 10,650. The average count was 21,000. Within 24 to 48 hours all of these counts were reduced to normal or subnormal limits.

The initial spinal fluid cell counts varied greatly. The highest count recorded was 48,180. The lowest was 16. It should be noted that this low count was seen in a patient who developed turbid fluid after admission and was found to have a count of 11,270 the next day. The average count was 11,800.

Without exception there was an appreciable drop in all spinal fluid cell counts within 48 hours after the initiation of specific treatment.

An attempt was made to correlate the spinal fluid concentration of sulfapyridine and the concentration found in the blood. Because of the burden of work carried by the laboratory during this period, only essential studies were ordered, consequently there were very few blood concentration determinations done. Those available showed sulfa-



1. SHOWING DECLINE IN SPINAL FLUID CELL COUNTS AFTER INSTITUTION OF SPECIFIC TREATMENT ON 10 REPRESENTATIVE CASES.

pyridine to be absorbed in the spinal fluid in relatively large amounts:

Blood 9.9-----	Spinal fluid 7.4 or 75 percent
Blood 4.9-----	Spinal fluid 6.7 or 79 percent
Blood 4.6-----	Spinal fluid 4.9 or 94 percent
Blood 3.6-----	Spinal fluid 4.8 or 75 percent

As previously stated, an attempt was made to attain and maintain a spinal fluid level of 10–12 mg. percent of sulfapyridine. This figure approximates the mean of the series. However one reading of 29.2 mg. percent was recorded. This patient responded satisfactorily with no untoward effects. Another patient in whom a concentration of 18.2 mg. percent was reached developed a transient anuria that resolved after discontinuing the drug and forcing fluids.

It is interesting to note in this regard that unusually high sulfonamide values were found on four spinal fluid specimens during routine examination. An investigation revealed that the procaine used to anesthetize the skin and deeper tissues at the time of the tap, found its way into the specimen tube via the tap needle in sufficient quantities to produce a false sulfonamide value. The use of the anesthetic was subsequently discontinued.

In 32 of these cases gram-negative intracellular diplococci were found in the spinal fluid either by culture or smear. The majority were found on the smear prepared from the initial spinal fluid obtained.

CASE REPORTS

Case 1.—R. A. V., seaman, first class, was admitted to the hospital on February 9, 1943, at 1600. He was semicomatose on arrival. The history available was incomplete; however, he had been sick for 1 day with headache and vomiting. Physical examination disclosed conjunctival hemorrhages, numerous petechiae and purpuric patches over the trunk, arms, and lower extremities. There were numerous moist râles over both lung fields. Reflexes were not remarkable. Spinal puncture revealed turbid fluid under increased pressure, with cell count of 1,200, and gram-negative intracellular diplococci were noted on the smear. The patient was given intravenous sodium sulfapyridine and 5 percent dextrose in saline. He developed signs of pulmonary edema and the fluid was discontinued. He was given atropine and placed in an oxygen tent. There was no response to the therapy and the patient died at 0118 on February 10, 1943, 7 hours after admission.

Autopsy, in addition to meningococcal meningitis, revealed pulmonary congestion and edema, splenic hyperplasia, minute hemorrhages of the skin, epicardium and the gastro-intestinal tract and cloudy swelling of the kidneys and liver.

Case 2.—F. A. J., mess attendant, second class, was brought in on Christmas Day. He was moribund upon admission and died 20 minutes later. The autopsy diagnosis was meningococcal meningitis.

CONCLUSIONS

A summary of 50 cases of cerebrospinal fever, meningococcal, has been presented. The mortality rate in this series was 4 percent. There were no fatalities among those receiving as much as 12 hours' hospital treatment.

Sulfapyridine was shown to be absorbed rapidly and showed in high concentration in the spinal fluid. In comparison with mortality

rates and complications observed in meningococcic meningitis prior to the advent of the sulfonamide drugs, sulfapyridine in large doses materially influences the course and the final outcome of epidemic meningitis.

The complications and sequelae observed in this group of patients were remarkably small. All 48 surviving cases are back on duty or convalescing satisfactorily and will be returned to duty in due time.



SURGICAL MAXIMS

1. "A good surgeon is an internist who performs operations."
2. The more mature and accurate the diagnosis, the less a surgeon will have to explore. Therefore, careful medical and surgical diagnosis is essential.
3. Clocking the surgeon to determine his speed used to be a habit among surgeons. More important is how cautious and how carefully the surgeon works—not how "fast" he is. A slow, careful operation is less apt to cause shock than one which is hurriedly and ruthlessly done in a few minutes.
4. Handle the tissues with loving kindness and they will heal in the same manner. This is a good maxim and is as important as asepsis in surgery.
5. The operative risk may be reduced by performing an operation in two or three stages if necessary.
6. There is no operation which has merit enough to be used on the patient who cannot stand it.
7. The greater the indications for surgery, the better the results.
8. Obese patients should not be subjected to abdominal operations (except in emergencies) until they have reduced.
9. Nature "in the raw" is not pleasing to our ethical or esthetic sense. However, a careful study of the manner in which animals care for their wounds may teach the surgeon that his chief function is to learn the methods of nature as best he can and help rather than hinder her efforts.
10. When not to operate upon a patient is as important to know as when to intervene.
11. Cautiousness is the byword of the surgeon.
12. All operations may be dangerous to life and may be followed by distressing after-effects.
13. Operations are to be avoided in the hysterical or mentally deranged except those of absolute necessity.
14. The surgeon must never minimize the dangers of surgery; he should not "sell" an operation to a patient and he must not promise that which is impossible or at most improbable.
15. The modern trend of surgery is toward conservatism.
16. The tacit or implied request of a patient on the operating table is: "My life is in your hands—be cautious; use all the skill, knowledge, and acumen you possess to cure me if possible and give me back to my loved ones."—Berman, J. K.: *Synopsis Of The Principles Of Surgery*. C. V. Mosby Co., 1940. Chap. 1, pp. 17-27.

TREATMENT OF CEREBROSPINAL FEVER, MENINGOCOCCIC ¹

THOMAS D. VAN ORDEN

Lieutenant Commander (MC) U. S. N. R.

and

CHARLES H. ARMENTROUT

Lieutenant (MC) U. S. N. R.

Recently much has been written concerning the sulfonamide drugs in the treatment of meningococcic meningitis. Different authors have advocated the various drugs of this group, with and without meningococcic serum. There is no doubt that there has been a tremendous lowering of the mortality rate by the use of these drugs, but whether or not it is advisable to use serum in conjunction with them is still questionable. This report deals with our experience in treating 39 cases at the United States Naval Hospital, Naval Operating Base, Norfolk, Va., during the past 4 months.

The severity of the infection varied greatly in different patients; in some, it was comparatively mild, while in others it appeared to be an overwhelming infection from the onset. The rapidity of onset of the symptoms of meningitis in many of these patients was quite startling. It was not unusual to get a history of the patient's having gone to bed the previous night feeling perfectly well, of having awakened during the night with a headache, and then of being delirious or in coma the following morning. A history of infection of the nasopharynx or of the upper respiratory tract was lacking in the vast majority of patients. Only 8 gave a history of a respiratory infection preceding the onset of meningeal symptoms. The duration of meningeal symptoms in all these patients before admission was less than 48 hours, with the exception of 2 cases, and in 12 of these cases the duration was less than 24 hours. The 2 cases in which the duration was over 48 hours had had symptoms of meningeal irritation for 3 and 5 days respectively. Both had received one of the sulfonamide drugs before admission. Neither was acutely ill when first seen, and only a slightly rigid neck and a positive Kernig were found on examination. Of the symptoms complained of at the time of admission, headache, nausea and vomiting, and stiff neck were the most frequent.

¹ Received for publication April 2, 1943.

All complained of headache, and in most cases, this was the initial symptom. Thirty-one complained of nausea and vomiting and 19 complained of stiffness of the neck. Fourteen patients were admitted in varying degrees of coma, and 12 were delirious and had to be restrained.

On physical examination, all patients showed varying degrees of rigidity of the neck; 24 had a definite opisthotonos and hypertonia. Twenty-two showed a definite purpuric eruption, and 4 of those had petechial hemorrhages in the sclerae and on the soft palate. One showed several petechial hemorrhages in the fundus of each eye. Thirty-three showed a very definite Kernig and Brudzinski reflex. The knee jerks and ankle jerks were increased in 31 and not elicited in 3 patients.

A spinal puncture was done on all patients as soon after admission as was possible and before medication was started. The spinal fluid pressure ranged from 120 to 580 mm. of water, and the appearance of the spinal fluid varied anywhere from one which showed a very slight cloudiness to those in which the fluid was quite milky. The cell count ranged from 480 to 85,000 cells per cu. mm. The smear showed the organism in all cases. In most smears many organisms were seen, but in one case only two pairs of diplococci were found. The cultures were positive in all cases.

The general outline of treatment followed in all these cases was fundamentally the same. All were given sulfadiazine with the exception of one case which was given sulfathiazole. In those which received sulfadiazine, the initial dose was 5 grams, followed in 4 hours by 2 grams, and then 1 gram every 4 hours until there was a fall in temperature and a definite improvement. This usually occurred in from 3 to 4 days. The dose was then changed to 1 gram every 6 hours for a period of about 10 days. In those patients who were unconscious or were vomiting, the initial dose, in the form of the sodium salt, was given intravenously. This was prepared by dissolving 5 grams of sodium sulfadiazine in 100 cc. of distilled water and was given by means of a syringe. In those patients who were still unconscious at the end of 4 hours, this dose was frequently repeated. As soon as the patient could take the drug by mouth, the oral method of administration was used.

The fluid intake was limited to 2,000 cc., and the intake and output were measured. In four cases, because of severe dehydration, it was necessary to give intravenous dextrose solution. To control the delirium, various barbiturates were used. Sodium amytal, in doses from 3 to 6 grains, and sodium phenobarbital, in doses of 2 to 6 grains, were given intramuscularly and intravenously.

In those patients who were delirious or in coma and showed no improvement, 24 hours after admission a second spinal puncture and withdrawal of from 25 to 50 cc. of spinal fluid was frequently done. In those in whom the pressure was excessively high, this procedure was definitely helpful.

Sulfadiazine blood levels were taken at various times during the treatment of these patients. The blood levels taken on the first day from 4 to 24 hours after treatment was started, varied between 12 and 18 mg. per 100 cc. of blood. There was a greater variation after the first day, these levels ranging from 4.9 to 16 mg. per 100 cc. of blood.

No serious complications were encountered in this group of patients from the use of sulfadiazine. Twelve patients showed hematuria during treatment, 3 occurring on the 3d and 4th days and the other 9 after the 8th day of treatment. In those who showed only microscopic hematuria, the treatment was continued, but in the 3 patients of our series who showed gross blood in the urine, the drug was discontinued. On withdrawal of the drug, there was a prompt disappearance of the red blood cells from the urine. One case had a leukopenia of 2,500 on the 8th day of treatment. Ten days after stopping treatment his white cells were within normal limits.

Of the 39 patients treated, 38 have recovered, or are in the process of recovering at the present time. No sequelae were noted in any of these patients, and except for those now in the hospital, all have been discharged to duty.

The patient who died was admitted to this hospital 24 hours after the onset of his illness, and 4 hours after the onset of convulsions. At the time he was first seen at this hospital, he was cyanotic, his skin was cool and moist, and he was having almost continuous convulsions. There were many purpuric spots over the chest, abdomen, and extremities. The spinal cell count was 14,000 cells per cu. mm. He was given sodium sulfathiazole, 3 grams intravenously at the time of admission, and another 3 grams within the next 8 hours. Various drugs, including sodium amytal, sodium phenobarbital, and pentothal, were given to control his convulsions. Sodium pentothal was given continuously for a period of about 30 minutes without any effects. He died 8 hours after admission. No autopsy was performed.

In comparing the various methods of treatment, the mortality rate as given by Meakins (2) is between 40 and 60 percent in this age group, using meningococcic serum. Waghelstein (3) treated 72 cases with sulfanilamide alone, with a mortality of 15.2 percent. Alexander reported 500 cases treated with sulfapyradine alone, with a mortality rate of 18 percent; Borden and Strong (1) reported 21 cases treated with sulfadiazine and polyvalent meningococcus serum with 1 death.

Leldman and Sweet reported 24 cases treated with sulfadiazine alone with only 2 deaths.

SUMMARY

1. Thirty-nine cases of meningococcic meningitis were treated, with one death. All patients were given sulfadiazine except the one who died, who was given sulfathiazole. This patient was almost moribund at the time of admission.

2. No serious complications were encountered from the use of sulfadiazine.

3. From the reports on the use of the sulfonamide drugs in meningococcic meningitis, sulfadiazine is apparently the drug of choice.

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A GENERAL CONSIDERATION OF METALS FOR BURIED APPLIANCES IN SURGERY

The whole question of suitability of metals for use in the body can be stated briefly as follows:

There are many occasions in surgery when a buried appliance made of metal is highly desirable.

Until very recently, all the metals and alloys which had been used were capable of producing unfavorable tissue reactions in the body.

Now it is known that an essential of any metal for use in the body is passivity or freedom from electroactivity in the body fluids.

Only three materials generally available seem to possess sufficient passivity to be used safely in the body: "18-8-SMO" stainless steel, which is relatively inert and can be adapted for small appliances such as wire or screws; tantalum, which is inert and will be useful when production problems are solved; and vitallium, which is inert, has been used widely, and has been found to be perfectly safe for any type of appliance, except wire, which requires malleability strength and the essential biochemical resistance.

As new alloys are developed some material which is inexpensive, strong, malleable, and free of corrosion in body fluids will undoubtedly be discovered. If there is no electrolytic activity about it, it will meet all the requirements of metals in surgery. Also, it will meet the standards of passivity which have been established by the Fracture Committee of the American College of Surgeons, which standards serve as a guide for subsequent developments of metals for use in surgery.—Venable, C. S., and Stuck, W. G.: A general consideration of metals for buried appliances in surgery. *Surg., Gynec. & Obst.* 76: 297-304, April 1943.

A PRELIMINARY REPORT ON MALARIA IN A COMBAT ZONE¹

JOHN F. BARBER
Lieutenant (MC) U. S. N.

The information herein contained has been gathered through observation of a group of men serving continuously in this tropic area for a 6-month period beginning in early September 1942. The intention in submitting such information for publication is twofold: First, to familiarize other medical officers who may serve in this area with some of the problems in the treatment and prophylaxis of malaria as we have encountered it here; second, to aid in the accumulation of data for a concrete answer to the question of what may be expected in the way of time lost due to malaria under similar conditions. The conclusions to be drawn from such a report must, of necessity, be limited, for the number of cases is small. In the report itself something over 100 cases are considered.

PROPHYLAXIS

Preceding prophylaxis, 2 cases of malaria were diagnosed by positive smear. Quinine was the drug first used, because atabrin was not on hand. This was continued for a period of 3 weeks, each man being required to take 8 to 9 gr. daily (measured in an empty 0.45 cartridge and wrapped in a small section of toilet paper). Since that period atabrin has been used exclusively. Recommendations as to the dosage and method of administration of the drug have been many and varied. I believe that the only way of assuring regular and effective medication is by roster, with each man's name being checked as he takes his medication, by the senior noncommissioned officer or section commander. Medical officers in this area have concluded that an adequate prophylactic dosage is four tablets (1½ gr. each) weekly. In an effort to maintain a more constant and, perhaps, more effective blood level each man is given a half tablet daily on weekdays, with a full tablet on Sundays. Since combining this dosage schedule with administration by roster check-off, atabrin prophylaxis, or, as I believe it is more rightly called, suppressive treatment, has been quite encouraging. Toxic effects have been at a minimum, with only a few men reporting mild diarrhea. No cases of intolerance have been encountered.

¹ Received for publication April 8, 1943.

CLINICAL CASES

At the end of the 6-month period herein studied 36.54 percent of the men have had clinical cases of malaria. It is definitely noted that the manifestations and course of the disease have markedly changed since the beginning of our experience.

The first cases were of the typical textbook variety, with symptoms, signs, and course following the expected pattern. During rigorous suppressive treatment, and probably as a result of the same, this has been changed. The cases we now are seeing are considerably milder. The fever is, on an average, lower, the malaise less severe, chills more infrequent, and recovery more rapid. It is still easily recognizable as malaria, but a malaria greatly reduced in its severity.

It is of interest to note that while the majority of our cases are diagnosed as malignant tertian (*P. falciparum*), the expected severity or malignancy has not been noted. All cases have responded well, the recurrence rate is not unexpectedly high, and there have been no deaths.

TREATMENT

We have used a routine of treatment combining quinine and atabrin. An attempt is made to establish the diagnosis by positive smear, even where this necessitates a wait of 24 to 48 hours, before the institution of treatment. Forty-five grains of quinine hydrochloride are given, divided into three to five doses daily for 3 days, followed by 30 gr. daily for 1 week. On the sixth day of the 30-gr.-per-day treatment one tablet of atabrin is given in addition to the quinine; on the seventh day this is increased to two tablets. Following this, quinine is discontinued and $4\frac{1}{2}$ gr. of atabrin are administered daily for 5 days. When this is completed the patient is replaced on quinine, 15 gr. daily for a period of 2 weeks. No discharge smears are made routinely. Upon completion of the entire course the patient is returned to prophylactic doses of atabrin. It has been found that hospitalization is not necessary for more than 5 to 7 days. Each man, however, has been carried on a light-duty status until the completion of the first quinine course. Results with smaller doses and less protracted courses of treatment have been discouraging.

RESULTS

At the end of the period under discussion we had treated 86 cases of malaria classified as new admissions, representing 36.54 percent of the group, and 19 readmissions, or 22 percent.

It is interesting to note that during the first half of the period, when prophylaxis was less rigidly supervised, the incidence was considerably higher than after accurate control of medication was assumed.

At the end of the first 3 months 29.5 percent of the command had had malaria. During the last 3 months there has been an increase of only 7.01 percent. Undoubtedly, considerable credit must be given to the institution of supervised efforts toward mosquito control, but the entire credit cannot be placed there.

At the end of the period of study a survey of the supposedly well men of the command was conducted through the cooperation of the Malaria Control Unit. Smears were examined from 224 men. Of these, 23 were reported as being positive. The men involved were immediately brought under observation; 2, who were found to have an elevation in temperature and clinical signs of malaria, were admitted. The others were apparently in good health. Excluding the 2 sick individuals, we consider that 9.37 percent of the command is, although asymptomatic and at their work, infected with concentrations of parasites great enough to yield a positive smear. It is quite certain that a larger percentage would be disclosed if repeated smears were taken.

CONCLUSIONS

It has been previously stated that this article is limited in scope. It does represent the course of an average unit through a tour of duty in a heavily infected malarial region and, therefore, what may be expected in others. I believe that the following conclusions are justifiable:

1. Suppressive treatment **MUST** be administered by organization roster in order to insure that medication is taken.

2. A satisfactory routine of medication is that outlined above; that is, daily administration of one-half tablet of atabrin, with a full tablet once a week.

3. Under such treatment the severity of the disease will be lessened, the course shortened, and the recurrence rate lowered.

4. In spite of thorough control, 9 to 10 percent of the men will show positive smears on a single slide survey, but—and herein lies the military significance—those men will be clinically well and able to hold their places at their guns.

PRIMARY ATYPICAL PNEUMONIA ¹

AN ANALYSIS OF THERAPEUTIC RESULTS IN 155 CASES

HOWARD L. CORRELL
Lieutenant (MC) U. S. N. R.

and

IRVING I. COWAN
Lieutenant (MC) U. S. N. R.

In recent years a number of clinically similar pneumonic syndromes have been described (1). In a few of these, various filtrable viruses have been found to be causative factors. In others, the cause has not yet been determined. The term "virus" pneumonia has been ascribed by some to this group, while the term "primary atypical pneumonia, etiology unknown," has been accepted by the Army and Navy medical services to classify this disease entity.

We are reporting our clinical experiences and therapeutic results in 155 unselected cases of atypical pneumonia which were clinically similar. None were of the pneumococcic types and 25 random cases gave negative complement fixation tests for influenza virus A and B.² No other studies relevant to the cause of the disease were carried out. All the cases were observed in the medical units of the U. S. Naval Training Station, San Diego, Calif., during 1942. They were all enlisted personnel between the ages of 17 and 35.

INCIDENCE

The month-to-month incidence was relatively constant, did not fluctuate with the incidence of upper respiratory infections and did not show any significant seasonal shift. One hundred and four cases occurred in recruit companies which were housed in close contact in standard type barracks for periods up to 2 or 3 months; these cases were spread through 94 companies, only 5 companies having an incidence of 2 patients each. This suggests a low degree of contagiousness for the type of pneumonia here described, and points to an etiologic distinctness from the common upper respiratory infections loosely classified as acute catarrhal fever.

¹ Received for publication February 18, 1943.

² Tests performed by U. S. Naval Laboratory, Laboratory Research Unit No. 1, University of California; Commander Albert P. Krueger (MC), U. S. N. R., in charge.

CLINICAL PICTURE

The onset was characteristically abrupt, with chilliness, a sharp rise in temperature from 102° to 104° F., sore throat, and, less frequently, headache.

Nonproductive cough developed within 24 hours in 87 percent of the cases and became productive in 4 to 7 days. Blood streaking was observed in only 3.3 percent of the patients. Twelve and four-tenths percent had no cough at any time during their illness.

Fever was remittent in character in 56 percent of the cases, intermittent in 44 percent; and characteristically fell by rapid lysis, usually in 6 to 8 days. Occasionally the febrile reaction never exceeded 100° F., and persisted only 24 to 48 hours. This is important inasmuch as the mild febrile reaction, minimal chest findings and appearance of relative good health will cause the examiner to miss an extensive consolidation in the lung unless the possibility is kept in mind and diagnostic x-ray studies are employed. In 37.2 percent fever never exceeded 102° F.

The patients appeared less ill than the fever would indicate, were never cyanotic or dyspneic, and had no elevation of respiratory or cardiac rate disproportionate to the degree of fever. The incidence of symptoms is shown in table 1.

TABLE 1.—*Incidence of common symptoms*

Symptom	Percent	Symptom	Percent
Cough.....	87.6	Headache.....	47.0
Sore throat.....	62.2	Weakness.....	44.0
Sweats.....	54.0	Chest pain.....	13.0
Chilliness.....	54.0	Vomiting.....	6.0

PHYSICAL FINDINGS

Physical findings were normal throughout the entire period of illness in 8.2 percent of the cases. In the remainder the signs were usually minimal, often surprisingly so when compared to the extensiveness of pulmonary changes demonstrable on x-ray. In 57.2 percent the first signs appeared within 3 days, whereas in 27 percent signs were delayed 4 to 7 days, in 5.5 percent from 7 to 9 days, and in 3.1 percent more than 10 days.

The incidence of the various signs, their incidence as an initial sign, and their incidence as the only sign throughout the course of illness is given in table 2. The rarity of marked dullness on percussion, tubular breath sounds, whispered pectoriloquy and increased tactile fremitus was especially outstanding.

The pneumonia was confined to one or both lower lobes in 92.8 percent and involved the upper lobe or 3 lobes in the remainder.

TABLE 2.—*Incidence of common signs*

Sign	Incidence	Incidence as an initial sign	Incidence as only sign
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Rales.....	91.8	65.9	17.9
Crepitant.....	62.9	56.2	6.9
Asthmatic.....	22.5	9.8	9.0
Mucous.....	6.4	3.5	2.0
Impaired percussion note.....	66.2	53.1	-----
Tactile fremitus:			
Increased.....	24.1	11.4	-----
Decreased.....	9.6	4.5	-----
Breath sounds:			
Reduced.....	23.4	12.4	-----
Tubular.....	6.9	6.2	-----
Whispered pectoriloquy.....	2.0	-----	-----

LABORATORY DATA

The white blood count was under 9,000 in 55.5 percent of the cases, under 12,000 in 95 percent, and never exceeded 19,000 per cu. mm. of capillary blood. The differential count was fairly normal, a slight elevation of the stab forms occurring in 36 percent of the cases. The sedimentation rate (Cutler) was elevated to an average of 21 mm. fall in 1 hour.

PROGRESSION OF MORBID PROCESS

Migration or extension of the pneumonic process to other lobes or to the other lung was observed in 12.6 percent of the patients who were followed by serial x-rays.

Resolution was delayed beyond 30 days in 14.5 percent of the 55 patients who were sufficiently followed by serial x-rays.

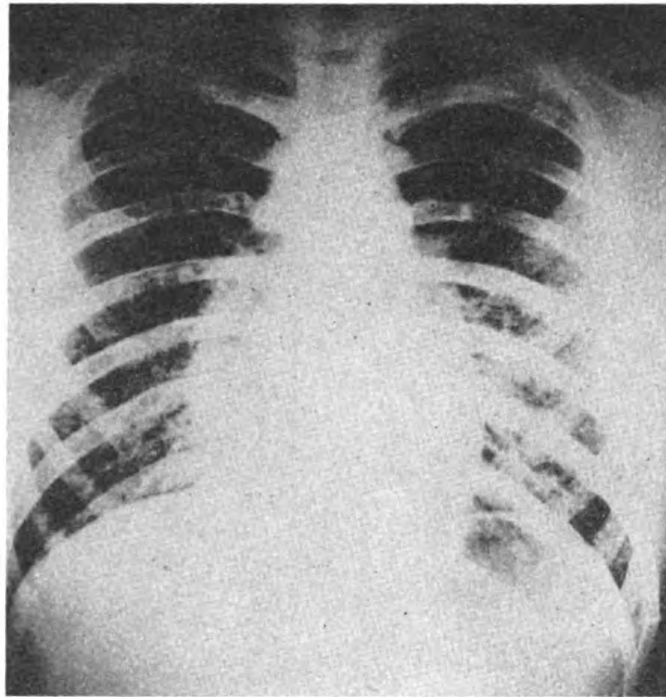
Pleural effusion developed in three patients and cleared in all without employment of mechanical measures. Diaphragmatic and pleural-pericardial adhesions were residuals in five instances, pulmonary fibrosis and interlobar fibrosis occurred once each.

ROENTGEN DIAGNOSIS

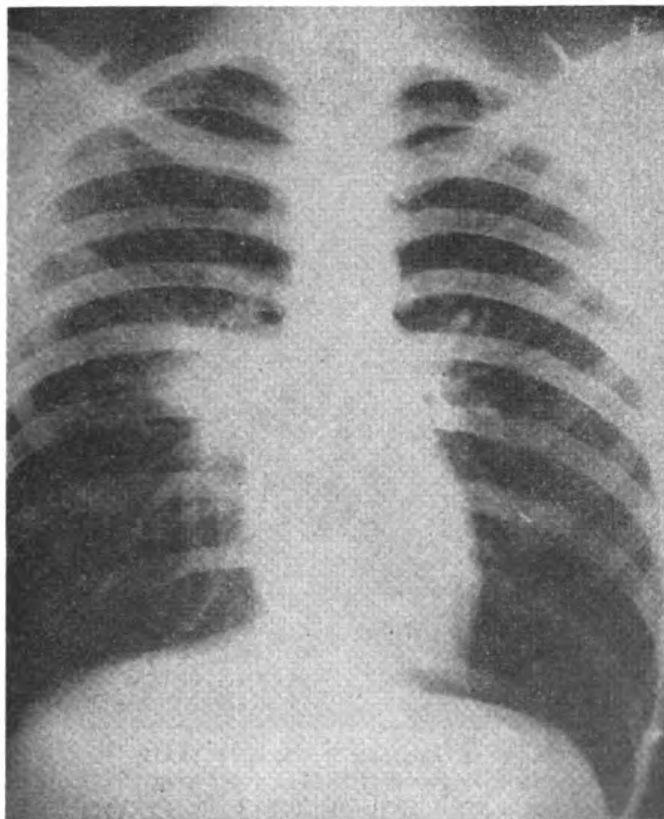
Roentgenograms must fulfill certain specific technical requirements in order to avoid overlooking this condition. The film should be on the "light" side in density; that is, the dorsal spine should never be visible through the cardiac shadow. An overexposed or "dark" film made in the early stages of this disease will eliminate or "burn out" the infiltration in the lung. The routine film consists of a standard 14 by 17 radiograph, made with the patient standing, and in the posterior-anterior position. If the lesion is suspected in the left lower lobe, a lateral view of this side should be taken. Films should be made with high speed technic, not over 1/10th of a second in time and at a 72-inch focal film distance. Both of these factors represent a standard chest technic used in most x-ray laboratories. Bedside films made with 30-milliamperage x-ray units have proved unsatisfactory due to the

lack of sharpness in detail of shadows, particularly in the region of the cardiac borders. (None of the patients were too ill to be brought to the x-ray department by stretcher or wheel chair.)

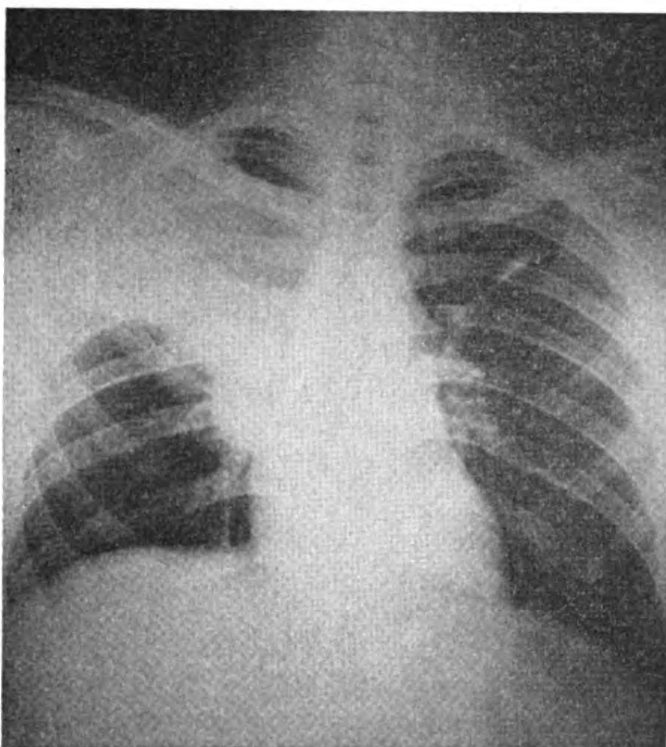
There is no definite characteristic roentgen appearance of this inflammatory disease of the lung. It usually presents a hazy, soft, string-like infiltration extending out of the hilus into the periphery of the lung (fig. 1). The process is most frequently noted in the lower lobes. However, there are two other roentgen types: One in which the film reveals a dense circum-hilar shadow with a fanlike infiltration into the surrounding lung tissue (fig. 2); the other type simulates in appearance an atelectasis of a lobe in that there is usually a diffuse veil-like shadow which occupies about two-thirds of the lobe (fig. 3). In our series of cases this type has never involved the entire lobe. There is no associated shift of mediastinal struc-



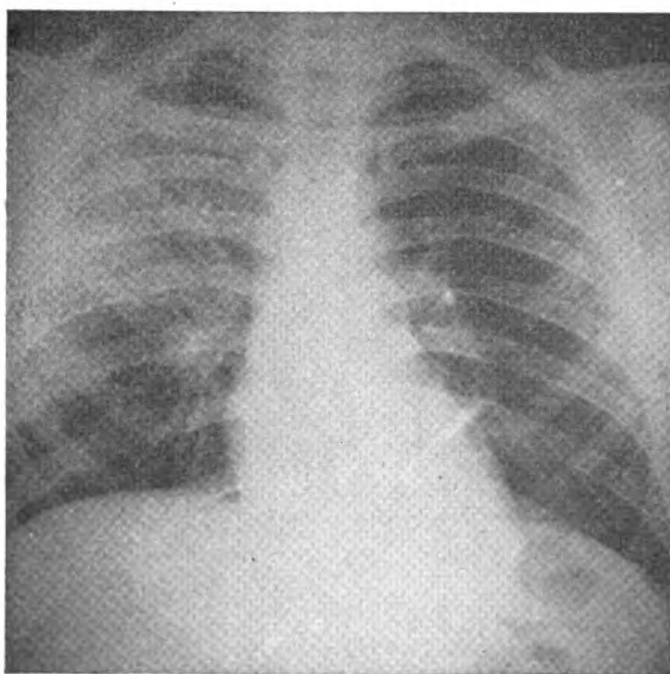
1. SHOWS THE MOST COMMON TYPE OF INFILTRATION IN THE LUNG; THAT IS, A HAZY STRINGLIKE SHADOW EXTENDING OUT OF THE HILUS INTO THE RIGHT LOWER LOBE. THERE IS A SIMILAR BUT LESS EXTENSIVE PROCESS IN THE LEFT LOWER LOBE.



2. CIRCUM-HILAR TYPE OF INFILTRATION WITH FINGERLIKE PROJECTIONS INTO THE LUNG, RIGHT.



3. ATELECTASIS-LIKE TYPE OF INFILTRATION IN THE RIGHT UPPER LOBE. NOTE THAT THE APEX OF THE LUNG IS CLEAR AND THERE IS NO MEDIASTINAL SHIFT



4. SAME CASE AS FIGURE 3. X-RAY MADE SEVERAL DAYS AFTER TREATMENT SHOWING THE CHANGE IN APPEARANCE TO A STRING LIKE TYPE OF INFILTRATION IN THE RIGHT UPPER LOBE. THE APEX OF THE LUNG IS STILL UNINVOLVED.

tures as one observes in a true atelectasis of the lung, and in addition, as the process resolves it takes on the appearance of the first type of primary atypical pneumonia (fig. 4). The roentgen type of lesion has no relation to the severity of the disease nor does it have any association with the general clinical picture. No specific type tends to predispose the patient to any of the reported complications.

In considering the roentgen differential diagnosis one must rule out bronchopneumonia and lobar pneumonia, both of which have very characteristic roentgen findings. Certain stages of broncho- and lobar-pneumonia may simulate primary atypical pneumonia. Severe forms of acute bronchitis may present a similar roentgen picture, so that, in the final analysis of the film, the clinical picture must be carefully reviewed in making an interpretation of the radiograph.

TREATMENT

It appears from the above that delayed resolution and migration of the pneumonia are the two frequent developments prolonging the period of illness. Treatment which would prevent either, would materially reduce the man hours lost through this cause.

In this group the patients were treated by: (1) Routine methods; (2) sulfathiazole; (3) sulfanilamide (both in adequate dosage); or (4) x-ray therapy. The number of each so treated and the results of treatment are shown in table 3.

TABLE 3.—*Response to various forms of treatment*

Treatment	Number patients	Total sick days	Total days of fever	Total days to clear by x-ray film	Days sick before x-ray therapy	Days to clear by x-ray film after x-ray therapy
Routine.....	72	11.8	6.8	23.4	-----	-----
Sulfathiazole.....	41	12.5	6.5	21.2	-----	-----
Sulfanilamide.....	10	11.8	6.4	20.0	-----	-----
X-ray treatment cases—acute.....	23	18.4	13.8	18.3	13.0	-----
X-ray treatment of unresolved pneumonia.	9	-----	-----	-----	133.3	14.0

¹ One patient who developed pleural effusion the day of therapy is the single failure to respond and is not included in the calculations of treatment results.

² Two of the 9 patients failed to clear within 1 week of x-ray therapy, are considered failures to respond, and are not included in the treatment response data.

Roentgen therapy was administered immediately following a positive x-ray diagnosis of pneumonia. A standard dosage was established based on the general principles of roentgen therapy as it is applied to infections (2) and on the experience of others (3) (4) (5) in treating pneumonia with x-rays. The patient was given 112 roentgen ("r") units of x-ray over the involved lobe and this was repeated in 24 hours if the clinical response was not satisfactory. It was found that two treatments were usually necessary and more than that number were never used. None of our cases showed any local or constitutional reaction as a result of treatment and no skin changes were noted.

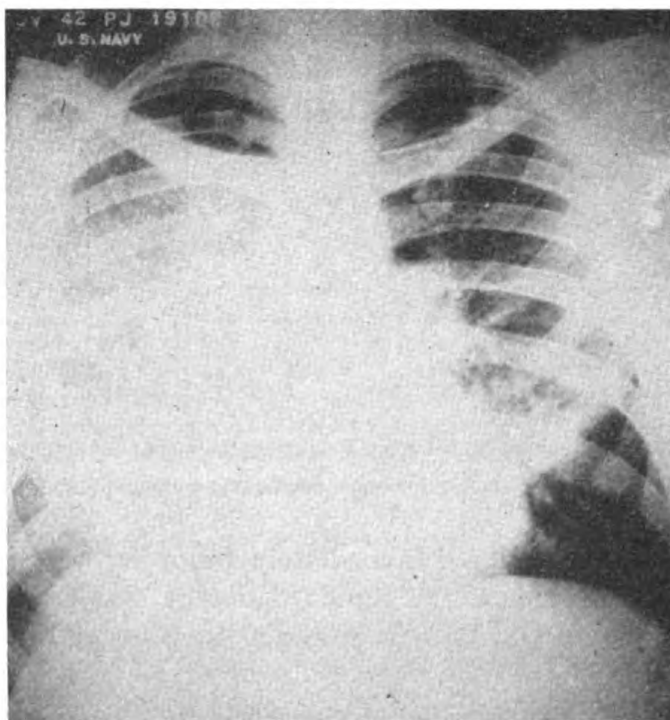
The equipment used was a standard full wave rectified diagnostic-therapy combination x-ray machine. The factors were as follows: 100 kv., 5 ma., 25 cm. target-skin distance, 2 mm. aluminum added filter, with a half value layer of 3.6 mm. of aluminum.

SUMMARY

1. The clinical findings and response to treatment in a series of 155 unselected clinically similar atypical pneumonias, which may be classified as primary atypical pneumonia, etiology unknown, are here reported.

2. The outstanding clinical symptoms were rapid onset with chilliness, intermittent or remittent fever lasting 6 to 8 days, sore throat,

nonproductive cough becoming productive in 4 to 7 days, and headache. Physical findings frequently developed late, and their paucity, when compared to the extensiveness of x-ray findings, was quite striking (fig. 5). Resolution as demonstrated by x-ray, usually took about 20 days. The infrequency of complications and sequelae, frequency of migration and delayed resolution, and failure to respond to sulfonamides, were the other characteristics of importance.



5. PATIENT HAD SYMPTOMS OF FEVER, NAUSEA, AND VOMITING; NO COUGH, NO CYANOSIS, NO DYSPNEA. THERE WERE NO PHYSICAL SIGNS AT THE TIME THAT THIS RADIOGRAPH WAS MADE. NOTE EXTENSIVE INVOLVEMENT OF THE ENTIRE RIGHT LUNG AND THE LEFT LOWER LOBE.

3. Not infrequently a febrile period of 1 to 2 days with temperature of 100° F., and a few chest findings may, on x-ray, prove to be an extensive pneumonia requiring 20 or more days for resolution.

4. The proper x-ray technic is important in order to avoid overlooking this type of pneumonia. The radiographs must be made with a so-called light technic, that is, the dorsal spine should not be visible through the cardiac shadow.

5. In 23 patients given x-ray therapy

within 4 days of admission, failure to respond to treatment occurred once (4.4 percent). In the remainder (95.6 percent) the febrile period, total number of sick days, and the days for resolution as proved by x-ray were reduced roughly one-half.

6. In nine patients failing to resolve within 30 days on routine or other treatments, as evidenced by radiological studies, 7 (77.7 percent) cleared to x-ray within an average of 4.0 days following 1 or 2 roentgen treatments of 112 "r" units each. Twenty-two and three tenths percent failed to be benefited by x-ray treatment.

7. Roentgen therapy, in our series, has shown definite promise in shortening the sick period of acute cases; appears to be of definite

value in shortening the period of delayed resolution; and may be of aid in decreasing the incidence of complications. We suggest its further trial in similar cases.

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ATABRIN AND CALCIUM IN TREATMENT OF TYPHUS

A specific for typhus fever is claimed by Van Meerendonk, in a combination of atabrin and calcium. Having treated 225 cases with atabrin the author was impressed with the reduction by $\frac{1}{3}$ in the case mortality in persons between 30-45 years. Severe cerebral symptoms were prominent. In most of the fatal cases the post-mortem finding was encephalitis; this and the occasional occurrence of a hemorrhagic rash indicated severe damage to the blood vessels, especially the capillaries. It was also noticed that the staining caused by atabrin was much more pronounced than in patients treated for malaria with the same doses of the drug. The author concluded that there must be a deficiency in the blood calcium, and this view was supported by the results which followed administration of calcium. All the severest cases in the 20 to 40 age group treated with calcium responded with a prompt fall in the temperature, and none of them died. Severe cerebral symptoms and deafness ceased to occur; the rash disappeared much earlier than in previous cases and never became hemorrhagic. Yellow staining also was much less. The calcium content of the blood in typhus patients was then estimated; it was found to be as low as 6 mg. percent. It was also noted that patients treated with calcium never had the abnormally low blood pressures which are so striking a feature of the disease, and that cardiovascular tonics were seldom needed.

The association between calcium deficiency and circulatory disturbances is stated to be one of cause and effect. It was, therefore, concluded that, whereas atabrin acts on the causal organism, calcium controls the organic changes occurring in the disease.

The treatment consists of one tablet of atabrin (0.1 gm.) thrice daily and at least 10 to 20 cc. of a 20 percent solution of calcium gluconate, or, if this is not available, of a 10 percent solution of calcium chloride, once daily. In severe cases doses of as much as 40 cc. of one of these solutions were given daily.—Van Meerendonk, P.: Experience in the treatment of typhus fever with atabrin and calcium. *Bull. War Med.* **3**: 398, Mar. 1943 (abstr. fr. *Deut. Militärarzt.* **7**: 541-2, Sept. 1942).

PRIMARY ATYPICAL PNEUMONIA, ETIOLOGY UNKNOWN¹

WARNE L. HAIGHT

Lieutenant Commander (MC) U. S. N. R.

and

JAMES H. TROLINGER

Lieutenant (MC) U. S. N.

The purpose of this paper is to call to the attention of the personnel of the Medical Corps a clinical entity recently recognized officially by the Bureau of Medicine and Surgery, and incorporated in the Diagnostic Nomenclature for the Medical Department of the United States Navy. For the official attitude of the Bureau of Medicine and Surgery the reader is referred to the Navy Department Bulletin of December 15, 1942. In the March 1942 issue of War Medicine is found a brief clinical description of the disease, and a formal notification of its recognition by the Medical Department of the United States Army. In addition to a brief survey of some of the more widely circulated work published on the subject, we wish to present some of our own findings and conclusions drawn from a series of 47 cases observed over a period of 3 months.

Although many aspects of this disease remain conjectural, enough is now known to assure its recognition from the clinical and roentgenographic features described on numerous occasions since 1935. Because of its predilection for adolescents and young adults, the common "silent" phase of its pulmonary manifestations, and the frequency with which its onset simulates the syndromes of "grippe" or "flu," it offers a possible diagnosis to be considered in every case which we label "catarrhal fever, acute."

As might be anticipated from the not inconsiderable literature of the past few years dealing with a condition not yet sufficiently understood or defined to appear in the more common current revisions of standard medical texts, the nomenclature by which it can be best designated and described remains controversial and confused. A universally acceptable designation must probably await the satisfactory proof of the etiological agent; however, the official recognition and identical nomenclature of the medical departments of both the Army and Navy is certainly an appreciable step toward a more general un-

¹ Received for publication February 6, 1943.

derstanding. The term "virus pneumonia" frequently has been employed inferentially when all efforts to recover pathogenic bacteria which could be considered causative have failed. Some of the designations which have been used, as listed by Dingle and Finland in their excellent survey on this broad subject (1), include: "Acute influenzal pneumonia," "acute pneumonitis," "pneumonitis," "acute interstitial pneumonitis," "atypical pneumonia with leukopenia," "atypical bronchopneumonia of unknown etiology," "disseminated focal pneumonia," and the now official, primary atypical pneumonia, etiology unknown. It was our policy, prior to receiving the Navy Department Bulletin previously mentioned, to employ the term "pneumonitis, acute."

ETIOLOGY

In this paper, primary atypical pneumonia, etiology unknown, will be referred to as a disease, although in the considered opinion of many workers on the subject it would more accurately be considered a syndrome, probably of multiple causes. Although the specific agent—or agents—responsible for this disease remains in doubt, there has been a great deal of interesting work done recently, militating, no doubt, toward the ultimate clarification of a very perplexing, though intriguing, problem. Most of the achievements to date are of interest more because of their implications rather than for any real conclusive light yet thrown on the subject. Reimann (2) has called attention to the probability of numerous causative agents. Among the viruses implicated by more recent reports were: (1) Those found antigenically related to that of psittacosis, of ornithosis, and of meningopneumonitis (3); (2) those similar to the virus of lymphogranuloma venereum (4); (3) that of lymphocytic choriomeningitis (in two unusual fatal cases of which Smadel and his associates (5) observed a patchy bronchopneumonia characterized chiefly by a mononuclear cell infiltrate); (4) those of influenza, chickenpox, smallpox, and so-called mongoose-infecting virus (6). A group of certain other agents, aside from the viruses, have also been regarded with suspicion, as the *Rickettsia* of "Q" fever, the protozoan *Toxoplasma*, and the fungus *Coccidioides immitis*—all these may cause disease resembling the pneumonias caused by viruses (6). The papers of Reimann and of Dingle and Finland survey this aspect of the disease quite completely.

We are presenting a series of 47 cases diagnosed in every instance by both clinical and x-ray findings. These cases were detected and treated in a United States naval mobile hospital outside the continental limits of the United States, in a subtropical climate, during the 3-month period between October 15, 1942, and January 15, 1943. During the same interval there was a total 168 admissions to the medical service.

From these statistics it becomes evident that 28 percent of the total medical admissions constituted the disease under consideration. Personnel suffering this entity have been admitted from rather widely divergent activities, including ships, 2 different naval operating bases, an air station, and our own activity. Cases were discovered in the Marine Corps, most of the commoner naval ratings, and among commissioned officers.

No satisfactory figures seem yet available regarding the incidence and epidemiology of the disease. Although reports would indicate a wide distribution, evaluation of the numerous small outbreaks and sporadic cases thus far reported is difficult, especially so in the light of limited recognition. The important bearing of this latter factor is given weight by our own experience:

TABLE 1.—*Admission diagnoses*

Diagnosis undetermined (influenza)-----	1
Asthma-----	1
Diagnosis undetermined (sinusitis)-----	1
Pneumonia, lobar-----	3
Diagnosis undetermined (tonsillitis, acute)-----	4
Diagnosis undetermined (bronchitis, acute)-----	1
Diagnosis undetermined (bronchopneumonia)-----	1
Diagnosis undetermined (catarrhal fever, acute)-----	25
Pneumonitis, acute-----	8
Alcoholism, acute-----	1
Tracheitis, acute-----	1

A glance at table 1 listing the diagnostic impressions of medical officers making the initial examination of these cases, just prior to their admission to this activity, will suffice to impress the reader with the pitfalls and errors to be anticipated in recognizing primary atypical pneumonia, etiology unknown. It would also seem to bear evidence to the common abuse of the diagnostic term, "catarrhal fever, acute." It was interesting to observe the increasing frequency with which these cases were diagnosed in the last month during our observation, when the medical officers of adjacent activities became familiar with primary atypical pneumonia, etiology unknown.

AGE DISTRIBUTION

As pointed out by Dingle and Finland, the age distribution in the reported outbreaks has thus far been almost entirely limited to adolescents and young adults. This observation regarding a more susceptible age group is borne out by data from civilian hospitals as well as that obtained from schools and military organizations where the age of personnel is limited. It should be borne in mind, however, that cases occur at all ages, patients having been reported whose ages vary from 4 to 80 years; indeed, Adams (7) (8) has described a virus pneu-

monia in infants similar to the entity under discussion and to which adults were not apparently susceptible.

Our youngest case was 18 years of age, while the oldest was 44. There were 4 cases over 40 years of age; 4 between 30 and 40; 20 between 20 and 30; and the remainder were under 20 years old. The average age in our series was 25 years. Of course, our patients were drawn entirely from service personnel; however, it is interesting to note that in the report of Goodrich and Bradford (11) of 52 cases in a civilian hospital, the average age was 27.7 years—the ages ranging between 52 and 9 years. Fifty percent of their cases occurred in the decade between 21 and 30 years. This, together with other similar reports, would certainly seem to indicate that our observations in this respect were not solely attributable to the limited age group with which we deal in the naval service.

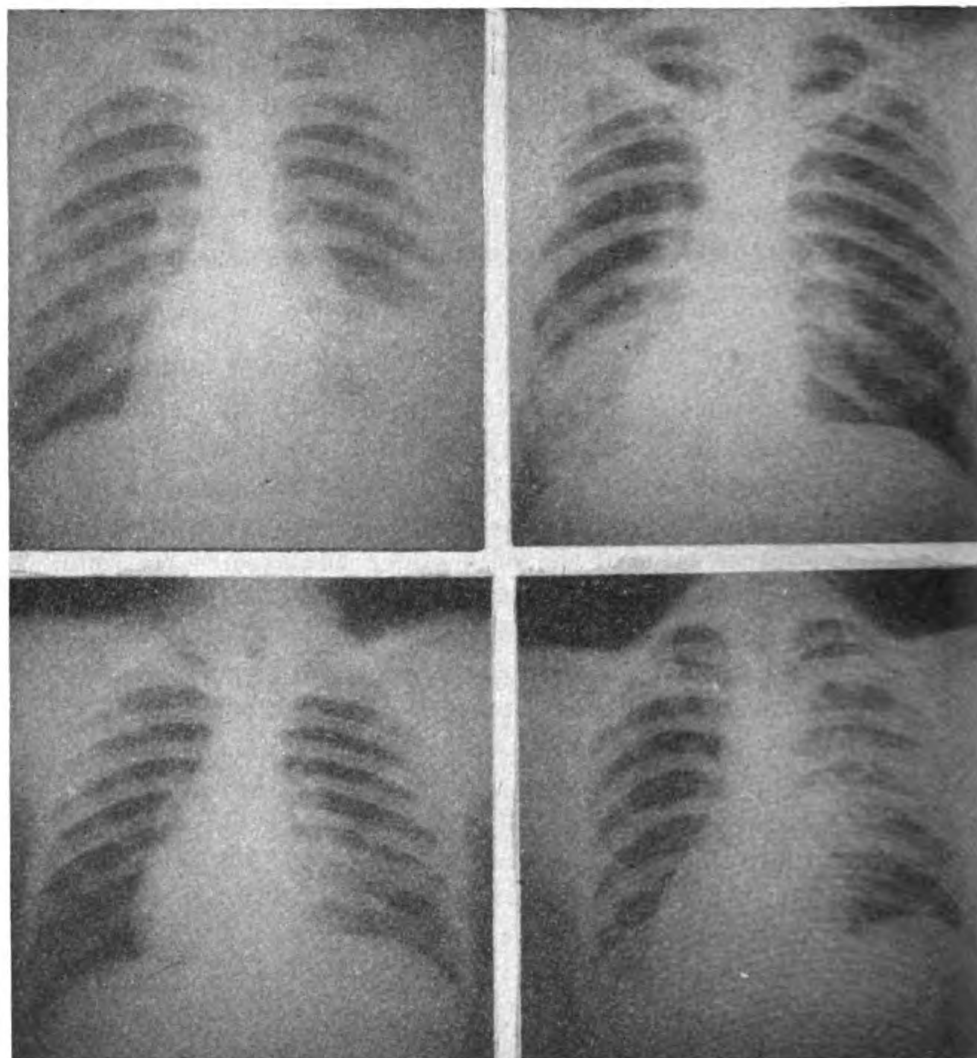
COMMUNICABILITY

In considering the spread of the disease, a most important aspect to members of the medical corps, one cannot be very deeply alarmed regarding its communicability by a study of our series of cases; nor, for that matter, from the reports of others read thus far. Drawn from at least five sources, none of the cases under discussion were found to have been in more than casual contact with each other prior to admission; none was found to have been sleeping within the immediate proximity of any other. Of the eight cases occurring in our own hospital staff, only two were in intimate contact with established cases of the disease on the wards—one corpsman and one medical officer. There was at least a month's difference in the time of their attacks. The remaining six cases involving staff personnel could hardly have been subjected to more than brief and intermittent exposure to the disease. Cases admitted to this hospital were not isolated, although efforts were made to segregate their beds on one side of the ward. Only two of our cases could conceivably have contracted the disease while patients in the ward, and only then by assuming the infection to have an incubation period of less than 1 week—an assumption, parenthetically, not in accord with the opinion of the majority of investigators, most of whom seem to consider it (admittedly without much reliable data) between 7 and 21 days. Reimann and Havens, however, believed that it might be as brief as 1 or 2 days. Any further comment regarding spread of the disease seems unwarranted, in view of the paucity of our information in respect to etiology, incubation period, communicability, and exact mode of spread.

CLINICAL FEATURES

Before describing this aspect of the cases under our observation, it should be clearly understood that only those cases are discussed or

included in this series which manifest unmistakable roentgenographic evidence of the disease. In view of its protean clinical aspects, together with its wide range of severity demonstrable in this series (both clinically and by x-ray), it may be assumed that the causative agent responsible for the pulmonary changes to be discussed causes an un-



1. HOMOGENOUS (UPPER LEFT).
3. LINEAR (LOWER LEFT).

2. MOTTLED (UPPER RIGHT).
4. MIXTURE (LOWER RIGHT).

ILLUSTRATIONS OF MAJOR CLASSIFICATIONS OF ROENTGENOGRAMS EMPLOYED IN OUR SERIES.

determined, and at present undeterminable, number of cases of respiratory illness. It may well be responsible for the loss of incalculable man-hours to the service, but indistinguishable at present from all the other infections now caught in the limbo of "catarrhal fever, acute."

Onset.—Although the onset has been described by most authors of the subject as slow and insidious, Daniels (9) and Murray (10) have

taken exception to that observation. In only five of our cases could the onset be termed abrupt or sudden.

The commonest complaints we elicited at the initial examination, in the order of the frequency with which they were encountered, were:

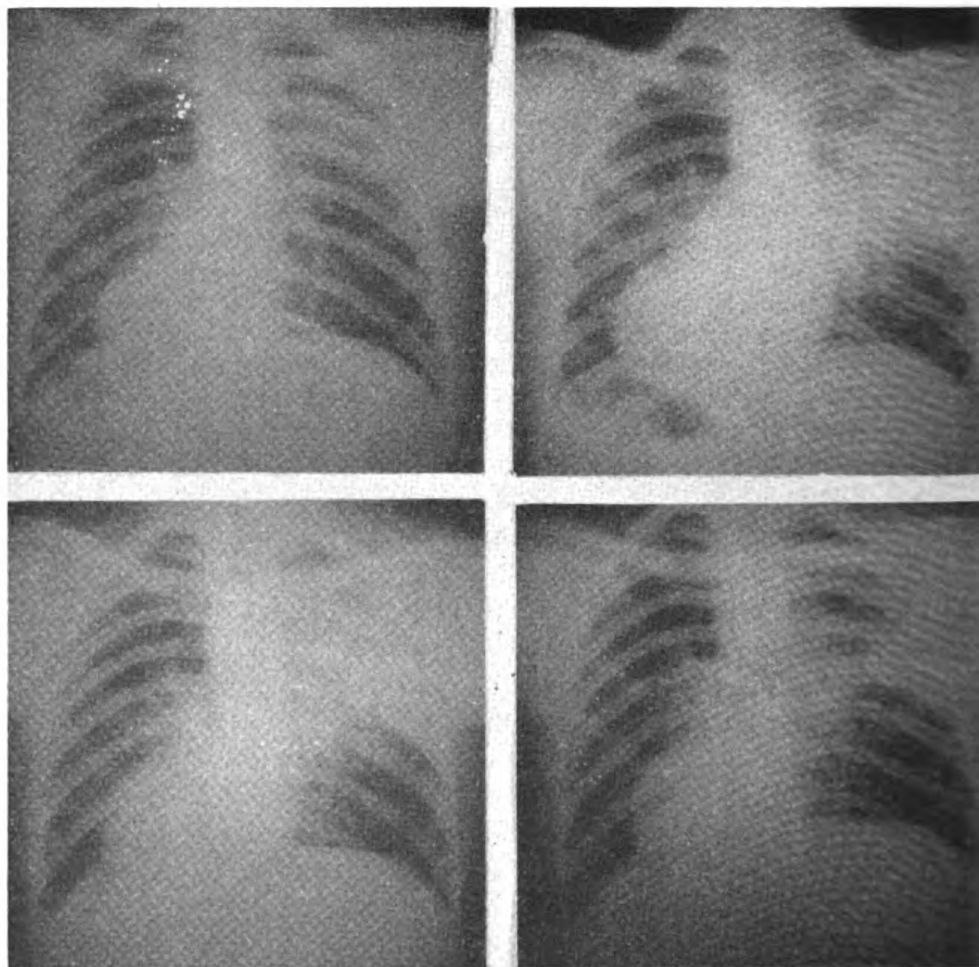
1. Chilly sensations (not frank, shaking chills) alternating with a feeling of—
2. Feverishness.
3. Headache, usually generalized with most marked distress in the frontal region.
4. Malaise and fatigability, with backaches and "sore bones and muscles."
5. Rather profuse sweats were frequently encountered, before the administration of any salicylates.
6. A definite tonsillitis and/or pharyngitis in nine patients, but did not persist after the first few days of illness.
7. Cough of varying severity and nature. Although a racking dry cough appeared at the onset in several cases, it was a much commoner experience to find the cough playing the predominant role after the disease had passed the acute phase; indeed, in the majority of cases it did not become distressing until the patient was otherwise asymptomatic and with a normal temperature, when it was more likely to be productive of a muco-purulent sputum.
8. Hemoptysis was noted in four cases; it was not the rusty or "prune juice" sputum commonly associated with a lobar pneumonia, but rather a streaking or flecking of the sputum with relatively small amounts of blood. When observed, it was at the onset or very early in the course of the disease.

Two of our patients complained of mild attacks of epistaxis just prior to admission. Not a few of the cases under our surveillance complained at one time or another of rather vague chest pains, described as a dull ache or "tightness" rather than the lancinating stabs of pleuritis. The site of this discomfort, when present, was substernal or on the side of pulmonary involvement. In one of the mildest cases the only symptoms for 3 days at the onset were those of an acute tracheitis, with burning substernal pain and cough.

In the majority of our cases the temperature afforded the most reliable index of the clinical and x-ray severity of the disease. Six of the seven cases whose temperature reached or exceeded 103.8° F. were hospitalized for 20 days or more, as compared with an average of about 10½ days for the remainder of the patients. Pyrexia was usually of the sustained, swinging type, persisting 8 to 12 days. Especially noteworthy were the pulse and respiratory records, as demonstrated by that of a typical case (C) in figure 9. Invariably, even with the most marked pyrexia, the pulse was found to be out of proportion to the fever; in fact, a relative bradycardia obtained. As suggested by the normal respiratory rate of the record, no case suffered any dyspnea or orthopnea.

As would be expected from the multiplicity and variability of the complaints encountered at the onset, the clinical picture of this disease was extremely variable in nature and in severity. Several cases manifested a rhinitis, pharyngitis, or tonsillitis which cleared rapidly under

symptomatic treatment during the first few days of their illness. The flushed facies of the fevered cases would be expected, but the often profuse sweating and slow pulse so often observed put one on his guard. In only two cases was there any abdominal tenderness, and it was an evanescent and ambiguous finding in them. None presented any rash, lymphadenopathy, splenomegaly (occasionally reported by other



5. DECEMBER 31, 1942 (UPPER LEFT).
7. JANUARY 6, 1943 (LOWER LEFT).

6. JANUARY 5, 1943 (UPPER RIGHT).
8. JANUARY 10, 1943 (LOWER RIGHT).

ROENTGENOGRAMS OF CASE C DEMONSTRATING X-RAY COURSE OF ILLNESS FROM ONSET TO ALMOST COMPLETE RESOLUTION.

writers), or hepatomegaly. Their clinical appearance was almost always benign, and although a majority of the patients complained quite bitterly of headaches at the onset, no signs of meningeal irritation were elicited. In view of these observations at the bedside, our very frequent amazement and early confusion at the x-ray viewing box would now seem understandable.

A noteworthy finding in every case, except the very mildest, was an appreciable loss of weight, often quite sharp during the first week

of illness. The weight loss varied between 5 and 30 pounds during the course of the illness, averaging about 12 pounds. Five patients went through their entire course of illness without developing a cough, expectoration, or any other symptoms of the disease aside from a mild malaise; this in the face of definite x-ray evidence of pulmonary involvement.



9. CLINICAL CHART OF CASE C. NOTE THE RELATIVE ERADYCARDIA.

Physical examination of the chest.—This was often more confusing than helpful in the cases seen early—confusing in that one is often given a false sense of security by the complete absence or doubtful and nonlocalizing nature of the pulmonary signs. In every case brought to our attention, however, sooner or later, there were chest signs adequate to indicate a radiographic examination, if not a sufficiency to localize the lesion. Unfortunately, in a large percentage of cases the signs do not appear until the pulmonary involvement is

actually clearing or "resolving," usually while the patient is coughing and expectorating. Many cases, nevertheless, manifest throughout their illness a suppression of breath sounds over the involved regions; this sign we found to be the most common and reliably localizing of any physical finding. Râles of all types and variations were audible at one time or another, but were frequently misleading and almost never localizing. Changes in voice sounds and fremitus, when observed, were not marked; and were usually equivocal, offering little aid in physical diagnosis. Examination of the chest films often elucidated one possible cause for our common errors in physical diagnosis, namely, the many cases revealing only a hilar or deep-seated right lower lobe involvement, very often at the right cardiophrenic angle. Another noteworthy discrepancy between clinical and x-ray findings was the extensive and often multilobar involvement observed by radiograph in patients with negligible physical signs.

Although 10 of our patients were moderately ill and appeared to be definitely toxic, none of them were cyanosed, dyspneic, or prostrated. None gave the appearance of being critically ill.

LABORATORY DATA

Blood count.—Unfortunately the cases were admitted to the hospital at varying stages of the disease, varying from the day of onset to several weeks thereafter. Our observations regarding the blood count bear out the conclusions drawn by previous authors that the white-cell count at the onset of the disease is either that of a mild leukopenia, or is an essentially normal count with a normal differential. Paradoxically, after the first few days of illness, and often when the patient was apparently improving clinically, the white count was observed to increase by 2,000 to 4,000 cells, with a moderate shift to the left. This rather striking finding would obviously account for the apparent discrepancy of the figures found in table 2.

TABLE 2.—*White-cell count*

Count	Percent of cases	Count	Percent of cases	Count	Percent of cases
5,000-6,000.....	14.2	9,000-10,000.....	21.4	13,000-14,000.....	3.58
6,000-7,000.....	7.1	10,000-11,000.....	3.58	14,000-15,000.....	3.58
7,000-8,000.....	21.4	11,000-12,000.....	3.58		
8,000-9,000.....	17.8	12,000-13,000.....	3.58		

Rarely did the blood picture manifest a leukocytosis and shift to the left even approximating what one would expect to find in a pneumococcal or other common bacterial pneumonia. The hematological examination is not without value, therefore, if only in a negative sense.

Sputum.—Although our facilities for investigation in this regard were necessarily limited by the nature of our organization, several smears, and frequently cultures, were done in each case. In none were pathogenic organisms found in the numbers or frequency which might establish them as the sole etiologic agent. The only pathogens found were pneumococci and staphylococci, and these in the sputa of only three or four patients, when they were present in negligible numbers. In the great majority of the sputa examined only the usual commensals were encountered.

Urine.—Routine and microscopic examinations of the urine were entirely negative in all but two patients who manifested a mild albuminuria during the febrile period of their illness.

Spinal tap.—This was performed on no cases, for although there was frequently a severe headache, never did we observe any nuchal rigidity or other neurological sign which might be indicative of meningeal irritation sufficient to warrant such a procedure. In view of the apparent etiologic role of a virus here, together with suggestive experimental work mentioned elsewhere, cerebrospinal fluid examination would be of interest, if only in a negative sense.

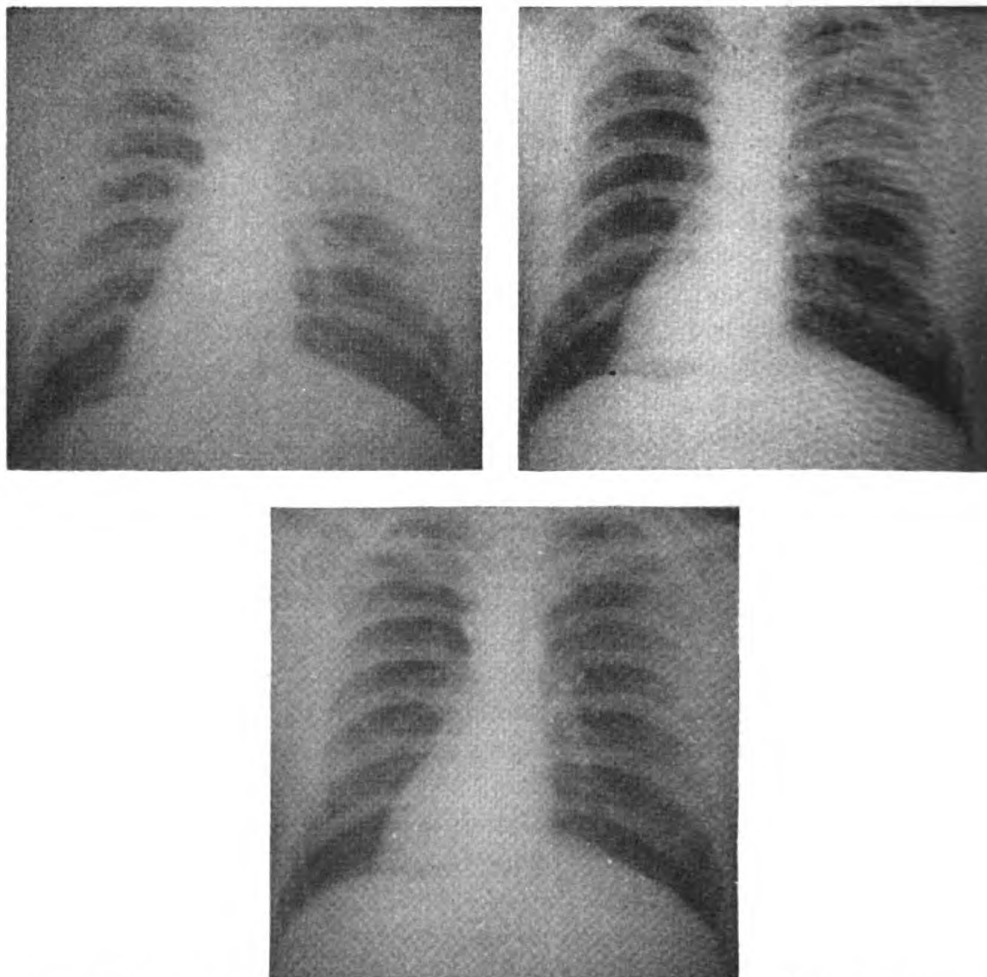
X-RAY FINDINGS

To us, a striking feature of these cases was, as described above, the fact that the roentgenographic findings were out of proportion to the physical signs.

The majority of the cases were unilateral, about 20 percent being bilateral. Upon admission, the amount of parenchymal involvement varied from a perihilar density to a partial involvement of four lobes. Often in the former case it did not progress but remained unchanged until resolution. On the other hand, spread to adjoining lobes was noted in some cases, and then it was invariably by the bronchial route. For purposes of classification the lesions were described as homogenous, mottled, linear, or a mixture of the three. In this series the cases were about evenly distributed among the four types (figs. 1 to 4). They had in common a soft appearance and displayed considerable variation in density. Accentuation of hilar and linear markings either unilaterally or bilaterally was a feature of all but two cases. However, the density was very rarely as marked and circumscribed as in pneumococcic pneumonia. Lower-lobe involvement was the most common, the right lower lobe and particularly the right costophrenic angle being the sites of predilection. A fanlike distribution at the hilar region was not uncommon. In only one case was there complete involvement of an entire lobe; in the remaining cases there was only about a 40-percent involvement of any particular lobe. It was noted that

seldom did the mottled type spread and become confluent; that is, the original lesions usually retained their original appearance until resolution was initiated.

The so-called migratory type was not observed, migratory being used in the sense of involvement of the contralateral side, subsequent to the roentgenographic appearance of the initial lesion. In the cases



10. DECEMBER 16. (UPPER LEFT).

11. DECEMBER 21. (UPPER RIGHT).

12. DECEMBER 30. (LOWER).

SHOWING RESOLUTION IN CASE F IN 14 DAYS.

with unilateral involvement it was common to see the hilar and linear markings on the opposite side become markedly accentuated just preceding resolution or, even earlier in the course of the disease, usually during an afebrile period. Since there was no recrudescence of the initial clinical picture, we believe that this was not an extension of the pneumonia. Following resolution the aftermath was invariably an accentuation of the hilar and linear markings. In some cases it persisted for as long as 60 days.

The duration of the radiographic findings was extremely variable, the shortest being a case in which there was 100 percent resolution in 7 days; on the other hand, the longest which we observed was 62 days, with 25 percent resolution. The average was 13½ days. The quantitative parenchymal involvement apparently had no direct relationship to the severity of the illness as observed clinically. For example, of the 10 most severely ill patients in our series, 3 had involvement of 4 lobes, 3 of 1 lobe, and 4 of 2 lobes. In none was there more than 40 percent involvement of any one lobe.

The homogenous type lesion occasionally presented the appearance of pleural thickening, but in serial roentgenographs it was seen to become mottled and linear. This, together with the absence of any clinical evidence of pleuritis, convinced us that this type lesion was solely parenchymal in nature.

In none of the cases was seen effusion, empyema, or lung abscess. Figures 5 through 12 illustrate the roentgenographic course of primary atypical pneumonia. The amount of involvement is more extensive than in the average case.

TREATMENT

Therapeusis in our series of cases was limited, in all but four patients who received sulfathiazole, to general hygienic and supportive measures. Our limited experience with the sulfonamide was in keeping with the observations of previous writers, in that no apparent beneficial effect was noted with the use of these drugs. To our knowledge, no specific agent has yet been offered in the treatment of this disease. It was our policy to maintain the patient on complete bed rest until he was afebrile and asymptomatic for several days, offering him a liquid or soft diet, insuring a fluid intake of 3,000 to 6,000 cubic centimeters daily, and administering Dover's powder or salicylates for his malaise. As Reimann has pointed out, the use of salicylates should probably be limited in view of the hyperhidrosis so frequently observed. We have tried various expectorants, cough sedatives, and steam inhalations in the more severe cases with variable results. Certainly those patients with the nonproductive, paroxysmal, racking cough deserve codeine or other sedative in adequate dosage to control this troublesome symptom.

SUMMARY

We have essayed an elucidation of the syndrome or disease, primary atypical pneumonia, etiology unknown, by briefly reviewing available literature and presenting our own findings and conclusions in a series of 47 cases. Although the disease does not seem to be highly communicable, its incidence may be much higher than generally appreci-

ated in view of its as yet limited recognition. We have found the following aspects of greatest value in diagnosis:

1. Benign clinical appearance.
2. Gradual onset, with chilly sensations, headache, and malaise.
3. A relative bradycardia—pulse rate out of proportion to fever.
4. Suppressed breath sounds as the most reliable and localizing of the usually deceptive pulmonary signs.
5. An essentially normal hemogram and sputum flora.
6. An x-ray film of the chest as the final court of appeal, without which few cases can be definitely diagnosed.

There were no complications (pleural effusion, empyema, secondary invaders, abscess, pleuritis, or bronchiectasis) in our series. The disease is apparently unaffected by the sulfonamides, treatment being symptomatic and supportive.

Addendum.—In the 2 weeks subsequent to the completion of this paper, there have been admitted to our ward 12 additional proved cases.

The authors are indebted to Clyde H. Hebert, pharmacist, U. S. N., and to James E. North, pharmacist's mate, second class, U. S. N., for technical assistance in the preparation of photographic reproductions of roentgenograms.

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PNEUMOHYDROPERICARDIUM ¹

A REPORT OF THREE CASES

RICHARD A. KERN

Captain (MC) U. S. N. R.

and

ELLWOOD W. GODFREY

Lieutenant (MC) U. S. N. R.

That air in the pericardial sac is of rare occurrence is evident from even the relatively meager literature available in the library of this hospital ship. In the thirteenth edition of Osler's textbook, edited by Christian, pneumopericardium is called "an excessively rare condition of which we have seen but one instance," and the same book cites James, whose series of collected cases number only 38. Paul D. White speaks of pneumopericardium as a "very rare condition" and gives no personal observations. In no clinical text consulted were we able to find any reference to the presence of both air and fluid in the pericardial sac except in instances of tuberculous pericarditis in which effusion fluid was in part replaced by air as a therapeutic measure. Yet the combined presence of air and fluid in the pericardial sac is of the essence of this condition, their relative proportions determining, as we wish to show, both the physical signs and the radiologic findings. It therefore seems justified to place on record our observations in three cases of pneumohydropericardium recently encountered on board the U. S. S. ———.

Causation of pneumopericardium.—In James' 38 cases, perforation of the sac was responsible for the condition in 33 patients. Of these, 7 were due to perforation of the esophagus and 8 resulted from external penetrating wounds of the chest. In the 5 cases without perforation of the pericardium, an infection by a gas-producing bacillus was considered as the possible cause. White states that pneumopericardium is due to the entrance of air from a pneumothorax, from esophageal or bronchial perforation, from a faulty paracentesis, or, rarely, when air is introduced for the treatment of tuberculous effusion. According to White, "trauma may cause rupture or perforation of the pericardium without injury to the heart. If the lung or a pneumothorax perforates into the pericardium by trauma or disease, air enters (pneumopericardium)." In the patient cited in Osler, the rupture of a carcinoma of the stomach into the pericardium was the underlying

¹ Received for publication February 10, 1943.

cause. Kerley believes that pneumopericardium is usually the result of paracentesis or of mediastinitis, the latter being primarily due to an inhaled foreign body or to a septic growth of the esophagus.

Causation of pneumohydropericardium.—This must be along the lines similar to those of pneumopericardium. In all of our patients a pneumohydrothorax was present; in one due to fracture of ribs from external violence, in the others to gunshot wounds of the scapular regions with probable injury of the lung. In each case the violence of the trauma was undoubtedly sufficient to produce a tear in the pericardial sac, thus permitting air from the pneumothorax to enter. The development of serous effusion in the course of a pneumothorax is of common occurrence, probably as a result of an inflammatory reaction of the parietal pleura to the air. Whether the fluid in the pericardial sac is produced in an analogous manner, or whether both air and fluid pass from the pleural to the pericardial space, we cannot answer; our cases were recognized too long after the original trauma and could be followed for too short a time. The different levels of air and fluid in the two spaces, both when the patients were first seen and at examinations a week later, suggest that at the time of these examinations there was no longer an open communication between these spaces. It would therefore seem a little more likely that the fluid observed in the pericardial sac actually arose there.

That pneumothorax in itself should predispose to the development of pneumopericardium does not seem very likely. There is no mention of pneumopericardium in relation to spontaneous pneumothorax, a relatively common condition. A traumatic pneumothorax is the type that is implicated. This suggests at first glance that the same trauma which tore the lung is also responsible for the tear in the pericardium. But this would not seem to be the case in our patients. In all 3 it would appear that the pleural injury was the result of mechanical violence directly applied; splinters of broken ribs, or metal fragments. But in no instance were these latter actually in contact with the pericardial sac. Therefore, indirect trauma to pericardial attachments, such as when a blow on the chest causes a sudden violent shift of the heart to one side or the other, would seem to be the more probable mechanism of the pericardial tear. Pneumopericardium would then result only if pneumothorax were present at the same time. But pneumothorax is not a common complication of external violence to the chest resulting in rib fracture. Black (cited by Osler) found pneumothorax relatively rare in patients with broken ribs (32 instances in 918 cases). The chance of a patient having both a pneumothorax and a pericardial tear through which pneumopericardium could develop is therefore exceedingly remote, and would account for the rarity of this complication of chest injuries. War wounds, on the other hand, are

more likely to fulfill these requirements, thus accounting for our 3 cases in a series of about 75 cases of chest wounds with pneumothorax or pneumohydro-(hemo)-thorax.

Symptoms.—There is little or nothing in the way of a symptom picture that might be said to be characteristic of pneumopericardium or of pneumohydropericardium. This is probably due to two reasons. The pericardium is a comparatively insensitive structure. Even acute pericardial disease rarely gives rise to symptoms, unless rapid and marked distention of the pericardial sac, as in cases of severe hemo-pericardium, hinders the function of the heart (tamponade), or unless the adjacent sensitive pleura is also affected, giving rise to pleural pain. The second reason for the lack of a distinctive symptom picture of pneumopericardium or pneumohydropericardium is that the condition is almost always secondary to disease or injury of adjacent structures. Therefore the symptoms which the patient presents are overwhelmingly those of the underlying condition responsible for the pericardial complication.

Physical signs.—Osler speaks of the physical signs of pneumopericardium as "most characteristic." "Tympany replaces the normal precordial flatness. On auscultation there is a splashing, gurgling, churning sound, called by the French 'bruit de moulin'. This was described in 19 of the cases collected by James. A similar sound has been heard once or twice as an embolus was making its way through the cardiac chambers." White makes no mention of physical signs except "a tinkling splash with each heart sound." That the bruit when present is unmistakable can be attested to by one of us who has heard it in a patient with tuberculous pericarditis in whom, as a therapeutic measure, the fluid had been largely replaced by air.

We wish to call attention to certain factors which appear to be responsible for variations in the physical signs of this condition. They are the presence or absence of adhesions that would determine the possible loculation of air and fluid, and the relative proportions of air and fluid.

The presence or absence of adhesions that might interfere with the motility of the contents of the pericardial sac can markedly influence the physical signs. In our first patient there was apparently no interference with the movement of air and fluid. As a result, when this patient was examined in the upright position, the precordial dullness was present and apparently normal in outline and extent. On auscultation in the upright position, the heart sounds were of normal quality and intensity. As soon as the patient was placed on his back, the air bubble came into contact with the anterior chest wall, completely obscuring the precordial dullness, which gave place to an area of tympany. The heart sounds were then completely inaudible. The

significance of this fact may be appreciated in view of the fact that the patient was ambulatory, and was first examined in the sitting position with what were called normal cardiac findings. In the second patient there was fluoroscopic evidence that the air and fluid were largely, if not wholly trapped in the right half of the pericardium, possibly as the result of adhesions resulting from the original injury to that structure. In this patient, also ambulatory on admission, the cardiac outline on percussion and the heart sounds on auscultation were normal with the patient in the upright position. When he was placed supine, the cardiac dullness extended only to the left edge of the sternum, beyond which line to the right there was an area of tympany. Over this tympanitic area the heart sounds were absent. In the third patient there was similar evidence of loculation of air and fluid in the left side of the pericardial sac, with a shift in the position of the upper left border of cardiac dullness on change of position of the patient.

The second point we wish to emphasize is that the characteristic "mill-wheel" murmur heard in some cases of so-called pneumopericardium really depends, in all of the cases in which it is heard, on the presence of some fluid, so that these are actually all cases of pneumohydropericardium. The very nature of the sound (tinkling, churning, splashing, gurgling), suggests this. Why should the sign then be present in some cases and not in others? A splash is most easily produced when there is much air and little fluid. The roentgenologists comment on the remarkable activity of the heart shadow in patients with considerable air in the pericardial space. But the more fluid and the less air present, the less easily can a splash be produced. If the percentage of fluid in the pericardium exceeds a certain amount ("too full for sound or foam"), then the heart's motion is reduced to a normal degree, and no adventitious splash is produced. In none of our patients could such a bruit be elicited by change of position or induced cardiac overactivity (exercise). The probability of the presence of a characteristic murmur in pneumohydropericardium therefore stands in direct relationship to the amount of air, and in an inverse relationship to the amount of fluid in the pericardial sac.

It is conceivable that yet another factor might play a small part in the presence or absence of a mill-wheel murmur, namely, the specific gravity of the fluid. A thin exudate would be less likely to muffle a splash than would blood.

Roentgenologic Findings.—Kerley, in discussing pneumopericardium, says:

The x-ray diagnosis is simple. The gas-distended pericardial leaves are clearly visible on either side of the heart shadow. The amplitude of the pulsations of

the heart is considerably increased and is transmitted to the fluid level at the base of the pericardial sac. (Here actual mention is made of the presence of fluid in these cases).

Roesler speaks of three x-ray signs of pneumopericardium:

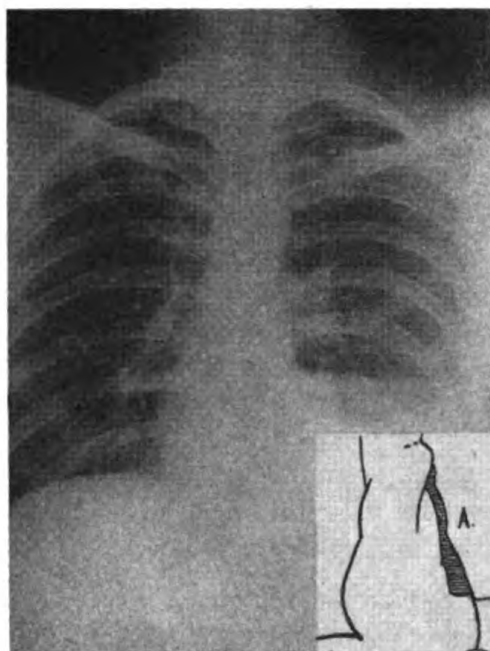
An area of increased transparency around the cardiovascular shadow in which the lung structure is markedly diminished or almost absent. This area of transparency is outlined along its periphery by a dense, ligamentous, curved shadow formation * * *. An unusual activity of the heart shadow is noted. A basal horizontal fluid level is commonly observed; it is continuously in motion. The activity of the heart shadow is most remarkable: The amplitude is considerably increased; it was determined to be as great as 1.7 cm. The systolic as well as the diastolic movement seems to take place much faster than normally. And finally, the heart mass swings and rotates considerably and shows hammerlike vertical movements. The normal lungs act, by means of their elastic traction, like reins on the cardiac pulsations, and the interposition of air frees the heart from this influence.

Roesler's excellent description needs amplification only insofar as the activity of the heart is modified by the amount of fluid present; the more fluid, the less is the heart free to move unduly fast or far.

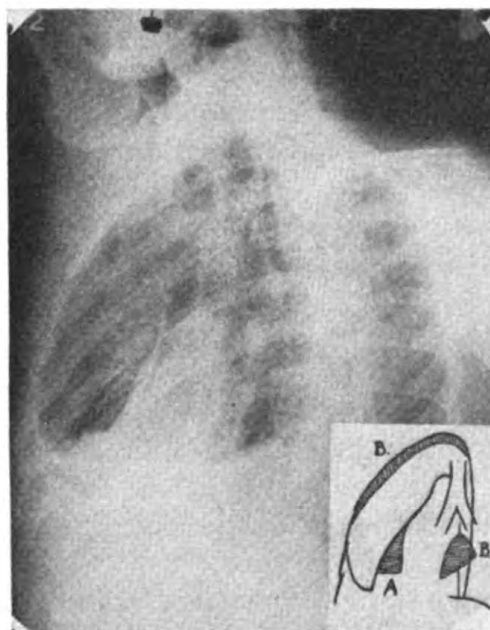
Roesler also points out that pneumopericardium must be differentiated from a collection of air in the mediastinum and from herniation of the lung. Neither of these conditions has "the characteristic bilateral delineation with origin at the level of the vessels." (We call attention, however, to the fact that a bilateral delineation is not present when air and fluid are trapped on one side, probably by adhesions, as in our second and third cases). Air in the mediastinum usually extends in the form of transparent bubbles into the soft tissue shadows of the neck. "Herniation of one lung towards the central side, occasioned by a pneumothorax, displays an arc-like deviation of the mediastinal pleura; under the fluoroscope one witnesses the respiratory to and fro movement of the arc with respect to the midline." To this we add that in the presence of a pneumothorax the motion of the mediastinal structures with respiration is paradoxical, and also the easy movability of the air bubble with shift of position of the patient will differentiate pneumohydropericardium, including cases with unilateral loculation, from herniation of the lung.

Prognosis.—This is obviously that of the underlying condition. Of the 38 cases collected by James, 26 died. Since all 3 of our patients were young men, previously in good health and with lesions in themselves not fatal, it is not surprising that they recovered.

Treatment.—Aside from the treatment of the primary cause, the only measures which might conceivably be required to apply to the pneumohydropericardium itself are *aspiration* in case the pressure within the pericardial sac rose sufficiently to produce tamponade (as shown by signs of heart failure and a blood pressure falling to danger-



1. CASE 1. POSTERO-ANTERIOR VIEW. LEFT-SIDED PNEUMOHYDROTHORAX AND PNEUMOHYDROPERICARDIUM. FRACTURED RIBS. NOTE THE SHADOW OF THE PERICARDIUM EXTENDING ALONG THE LEFT BORDER OF THE HEART (PERICARDIAL AIR (A) SHADED IN THE DRAWING).



2. CASE 1. RIGHT ANTERIOR OBLIQUE VIEW. THE PERICARDIAL AIR AND FLUID LEVEL ARE AGAIN DEMONSTRATED. THE PLEURAL EFFUSION AND AIR CAN BE SEEN BETWEEN THE SHADOWS OF THE HEART AND SPINE. THE SHADED AREAS ARE AIR OVER FLUID IN THE PERICARDIUM (A) AND IN THE PLEURA (B).

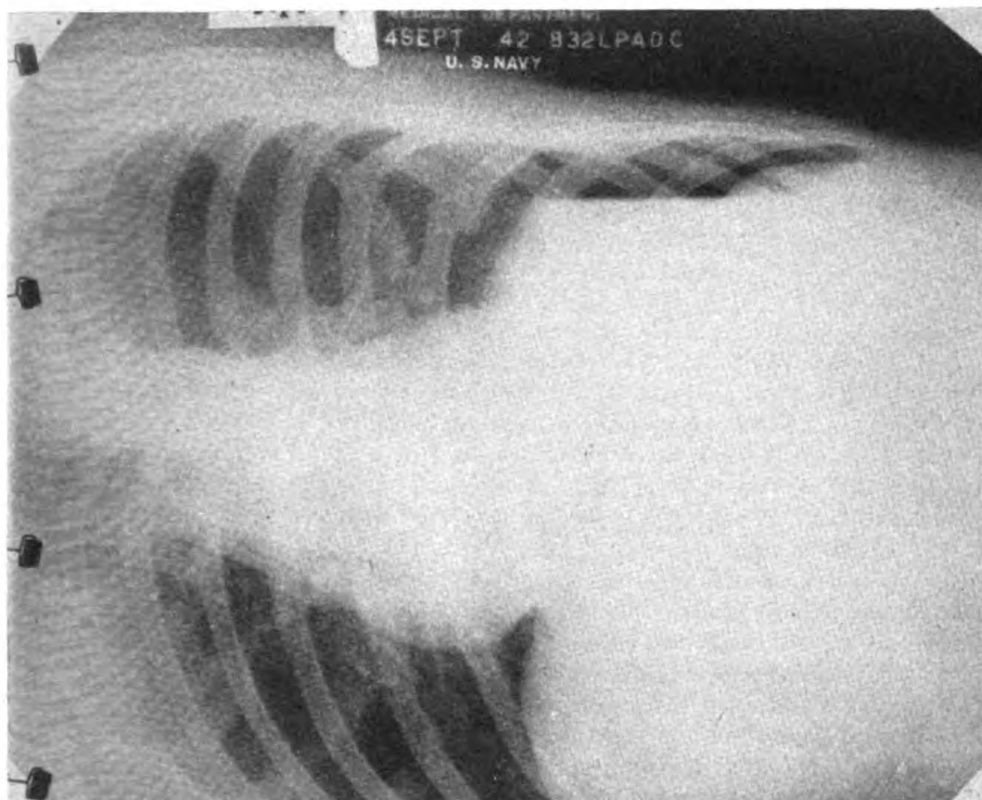
ously low levels, e. g., under 90 systolic), and *drainage* in case of infection. Of our patients, the two who had received gunshot wounds received sulfathiazole orally.

CASE REPORTS

Case 1.—T. J. C., a white male age 25 years, on August 7, 1942, was piloting a plane which crashed. He received fractures of the fourth and fifth ribs at about the anterior axillary line, the eighth rib at its posterior angle, and the ninth rib at its neck, all on the left side. The chest was strapped with consequent relief from pain. Without serious symptoms, he was ambulatory almost from the start. About 3 weeks after his accident he gradually developed a nonproductive cough and a little pain in the left side that caused the strapping to be replaced. On September 3, 1942, he was transferred to the U. S. S. —. Upon removal of the strapping there was no tenderness over the broken ribs locally or on indirect pressure, and no pain on full respiration or coughing. The patient was ambulatory and anxious to return to duty. Physical examination of the chest, however, showed signs of a considerable effusion in the left pleural space, extending as high as the fifth interspace in the midaxillary line. An x-ray examination was therefore made.

X-ray of the chest showed the fractures as noted above. Fluoroscopically the right dome of the diaphragm moved well and the costophrenic sulcus was clear. The right lung appeared normal.

The left dome of the diaphragm was fixed and there was a left-sided pneumohydrothorax, with the fluid level at the ninth rib posteriorly. The lung appeared to be 10 percent collapsed. In the right lateral decubitus the air and fluid were restricted to the lower portion of the chest, presumably by adhesions (figs. 1, 2, and 3).



3. CASE 1. RIGHT LATERAL DECUBITUS. THE LOCULATION OF THE PLEURAL COLLECTION IN THE LOWER CHEST IS SHOWN. THE RIGHT BORDER OF THE HEART APPEARS AS A DOUBLE LINE, DUE TO THE EFFUSION. NOTE ALSO THE COMPRESSION OF THE LEFT LATERAL CHEST WALL.

The heart and mediastinum were in the midline. There was a pneumohydropericardium, more apparent on, but not confined to, the left lateral portion of that structure. The upper level of the pericardial fluid was about midway between the pulmonary conus and the apex of the heart. There was some overactivity of the cardiac pulsations and the fluid level was in constant motion. There was no hammerlike movement of the heart.

Examination 5 days later showed no definite alteration in the air and fluid levels in pleura or pericardium.

In view of the roentgenologic findings, the patient was again examined. It was still impossible to demonstrate clearly the presence of air in the pleural space, there being neither a markedly shifting dullness (adhesions), nor a succussion splash. In the case of the heart, however, the signs were striking. When the patient was supine the cardiac dullness virtually disappeared and the heart sounds were inaudible. In the erect position the percussion dullness was normal in outline and the heart sounds could be clearly heard. The precordium was auscultated with the patient in various positions, but at no time was a mill-wheel bruit or other adventitious sound heard.

A chest tap was done under procaine anesthesia in the left posterior axillary line, seventh interspace, just below the upper limit of dullness. Ten cubic centimeters of a slightly bloody serous fluid were removed, and, when the needle point was tipped upward, 10 cubic centimeters of air were obtained, proving the presence of both air and fluid in the pleural space. Examination of the fluid showed no organisms on smear or culture. The sediment consisted largely of leukocytes, 70 percent of which were neutrophils.

Since the patient had a normal temperature and blood count, was free of symptoms, and showed diminishing physical signs, no further aspiration was performed.

On September 8th the heart sounds, with the patient supine, could be heard clearly during full expiration but were faint or inaudible during full inspiration. On this date he was transferred to another naval activity where he convalesced uneventfully.

Case 2.—C. T. C., a white man, age 24 years, was struck by a rifle bullet in the posterior aspect of the right shoulder on September 15, 1942. In addition to pain at the wound site and an inability to move his right shoulder, he experienced pain in the right chest, slight dyspnea, and cough productive of blood-tinged sputum. Within 24 hours after emergency dressing in the field, he was evacuated to a naval medical facility where the wound was opened by an incision $3\frac{1}{2}$ inches long, which, after appropriate local measures, was closed by suture.

On September 22, 1942, he was admitted to this hospital ship in an ambulatory condition, his right arm in a sling. There was some pain in the right chest on deep breathing. Physical examination disclosed evidence of injury to the bony structures of the right shoulder region, a little purulent drainage from one angle of the operative wound, and the signs of an extensive hemothorax with some air in the right pleural space. There was no displacement of the mediastinal structures, and the heart seemed normal. The patient's general condition was very good, with normal temperature.

X-ray examination of the chest showed a transverse fracture at the angle of the acromial process of the right scapula. The coracoid process was shattered. An additional fracture line running through the lip of the glenoid fossa and body of the scapula was evident. There were multiple small metallic fragments in the soft tissues surrounding the scapula, but none of these appeared to be within the thoracic cage. There were comminuted fractures of the right fifth and sixth ribs in the posterior axillary line. The remainder of the thoracic cage was negative.

Both domes of the diaphragm moved well with respiration. The left costophrenic sulcus was clear, and the left lung field was normal. There was a right-sided pneumohydrothorax, the apex of the fluid level being at the tenth rib posteriorly. The right lung appeared about 50 percent collapsed (fig. 4).

The heart and mediastinum were in the midline. There was a pneumohydropericardium which appeared loculated on the right side (fig. 5), as neither air nor fluid shifted away from that side when the patient was examined in various positions of decubitus. The size of the bubble and the apparent amount of fluid in the pericardial sac were distinctly less in this patient than in the previous one. There was a little increased movement of the right cardiac border, but no overactivity or hammerlike movement of the heart as a whole.

After these roentgenologic findings, one of us examined the patient for physical signs of pneumohydropericardium. In the erect position the outline of the heart on percussion and the heart sounds were normal. When he lay on his back, the air bubble replaced the percussion dullness between the left border of the sternum and the right cardiac border as noted in the erect position. Over this tympanitic area the heart sounds were inaudible. In no position was there any mill-wheel bruit or other adventitious sound suggesting pneumohydropericardium.

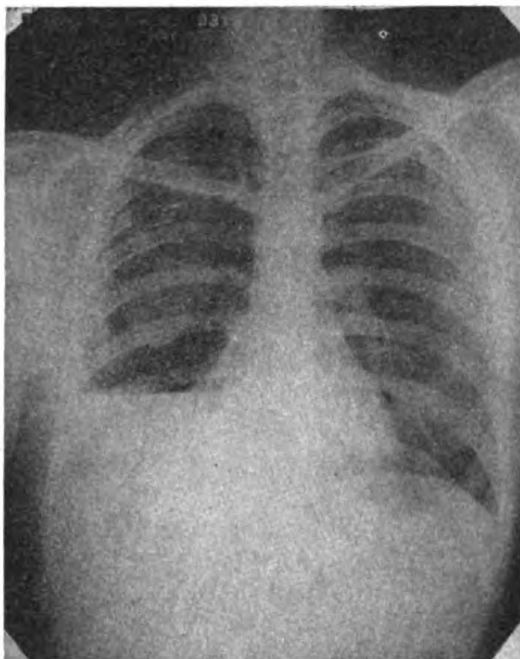
X-ray of the chest 4 days later showed no change in the pleural fluid level. The pneumothorax had decreased approximately by a half, with consequent re-expansion of the lung. The air in the pericardial sac had also decreased 50 percent, with no change in the pericardial fluid level.

Treatment consisted in local measures at the site of the wound and immobilization of the right arm in an abduction splint. Since there were no evidences of infection, and the signs of air in the pleural space showed regression, no aspiration was attempted. On September 29 the patient was transferred to another naval medical facility. He was in good condition, had neither cough nor dyspnea, and was ambulatory.

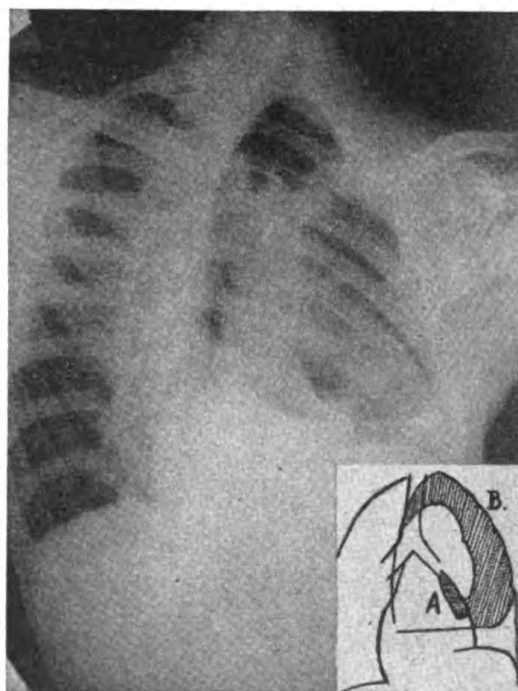
Case 3.—A. E. S., a white man, age 23 years, received a machine-gun bullet wound on October 27, 1942. The projectile entered about 4 inches above the left nipple, passed backward and slightly downward, and out through the scapula. The patient was not severely shocked, received emergency treatment in the way of local dressing of wounds and tetanus toxoid, and was evacuated. On November 3 he was received on this ship in good condition, but not ambulatory. He was a bit short of breath, had a heavy feeling in his left chest, but no pain. There was no hemoptysis at this time, but there had been on the day of injury.

Physical examination showed a slightly dyspneic patient with a clean, crusted puncture wound about 4 inches above the left nipple and a larger clean wound of exit through the left scapula. There was subcutaneous emphysema over the left upper anterior chest wall. There was diminished expansion of the left side, with flatness to percussion at the base posteriorly, and diminished breath sounds throughout. There was no demonstrable shift of heart or trachea. The hemoglobin was 65 percent and the leukocyte count 6,000. The patient's temperature was normal.

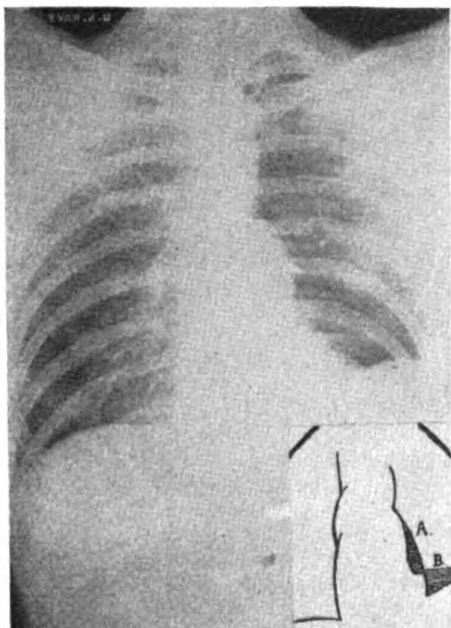
X-ray of the chest showed left-sided subcutaneous emphysema. There was a fracture of the left fifth rib in the posterior axillary



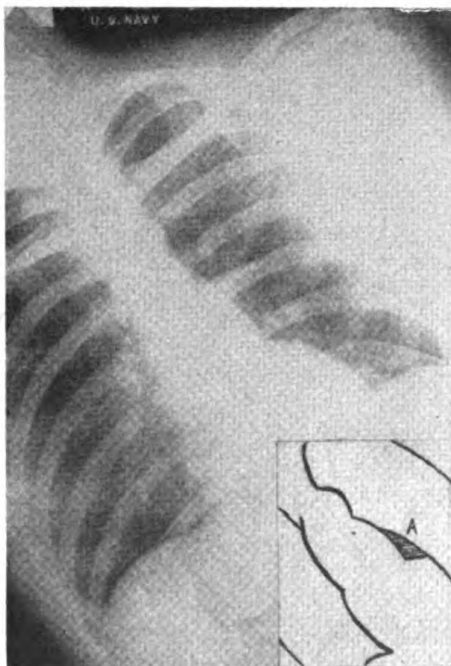
4. CASE 2. POSTERO-ANTERIOR VIEW. NOTE FRACTURES OF THE RIGHT FIFTH AND SIXTH RIBS IN THE POSTERIOR AXILARY LINE, AND OF THE RIGHT SCAPULA. RIGHT-SIDED PNEUMOHYDROTHORAX.



5. CASE 2. LEFT ANTERIOR OBLIQUE BOTH THE PNEUMOHYDROPERICARDIUM AND THE PNEUMOHYDROTHORAX ARE EVIDENT ON THE RIGHT SIDE. NOTE THE DIFFERENCE IN FLUID LEVELS IN THE PERICARDIAL (A) AND PLEURAL SPACES (B). ALSO NOTE THE METALLIC FRAGMENTS IN THE SOFT TISSUES.



6. CASE 3. NOTE THE PERICARDIAL AIR AND FLUID LEVEL ALONG THE LEFT CARDIAC BORDER (A). THE LEFT DOME OF THE DIAPHRAGM IS ELEVATED. THE FAINT HORIZONTAL LINE OF THE FLUID LEVEL OF THE PNEUMOHYDROTHORAX IS SEEN JUST TO THE LEFT OF THE PERICARDIAL FLUID LEVEL (B).



7. CASE 3. POSTERO-ANTERIOR VIEW. WITH THE PATIENT INCLINED TO THE RIGHT SHOWS A SHIFT IN THE AIR-FLUID LEVELS IN PERICARDIUM (A) AND PLEURA (B). NOTE THE SHADOW OF THE PERICARDIUM, CLEARLY VISIBLE AT THE EDGE OF THE BUBBLE.

line and the lateral border of the left scapula was also fragmented. There was no evidence of a radiopaque foreign body in the soft tissues.

Fluoroscopically the left dome of the diaphragm appeared elevated and fixed to the lateral chest wall. The midportion of this dome and the right dome moved well with respiration. There was a small left-sided pleural effusion confined to the posterior portion of the costophrenic sulcus. The left lung was approximately 20 percent collapsed, due to the pneumothorax. Both lung fields were otherwise clear. The trachea and esophagus were in the midline. The swallowing function was normal.

There was a small left-sided pneumohydropericardium, apparently confined to one side. The air bubble, smaller than that in the other two cases, was in evidence along the left cardiac border, just below the conus. There was no evidence of cardiac overactivity (figs. 6 and 7).

On November 4 one of us examined the patient. When the latter was in the recumbent position the upper left border of the heart was from 1 to 2 cm. nearer the midline than when he was erect. In the recumbent position the area over which heart sounds could be heard was definitely smaller than in the erect position. This suggested a movable air bubble in the pericardium, but was not conclusive evidence because of the considerable extent of the left-sided pneumothorax.

Three days later, x-ray showed complete absorption of the pericardial air, and the left lung had re-expanded approximately by half since the preceding examination.

On November 8 he was transferred in good condition to another naval medical facility where he convalesced uneventfully.

SUMMARY AND CONCLUSIONS

Our observations in 3 cases of pneumohydropericardium, encountered as a complication in a series of some 75 cases of traumatic pneumohydro-(hemo-)thorax, justify the emphasis of these points:

1. Cases of so-called pneumopericardium are actually cases of pneumohydropericardium, since there is usually some fluid in addition to the air in the pericardial sac.

2. The physical signs and the roentgenologic findings of pneumohydropericardium are dependent upon two factors:

(a) The presence or absence of adhesions that might determine the location and the mobility of air and fluid in the pericardial sac.

(b) The relative amounts of air and fluid present: The more air and the less fluid, the greater the likelihood that a mill-wheel murmur be heard and that excessive motion of the heart shadow be seen fluoroscopically.

‡ ‡

SEMIFLUID SULFONAMIDE

It has been proposed that when battle conditions prevent more complicated surgical procedures, wounds should be dressed with some semifluid sulphonamide preparation to suppress bacterial growth. A study has been made in rats of the histological reactions to various oils and sulphonamide preparations which might be used in this way.

It is concluded that the preparation of choice is the microcrystalline suspension of sulphathiazole or, failing this, an aqueous preparation of sulphanilamide as described. If oily preparations are employed, it is important to prevent any of the oil becoming embedded in the tissues; the least harmful oil histologically is cottonseed oil.—Hawking, F.: Histological reactions to oils and sulphonamide preparations. *J. Path. & Bact.*, 55: 41-52, 1943. London.

‡ ‡

STORAGE OF VITAMIN A IN THE BODY

It has been found that the human being whose stores of vitamin A are built up by administration of high dosages of this vitamin can withstand the effects of a vitamin A-poor diet for as long as several months.

While it is desirable to secure one's quota of vitamin A each day, yet it is good to know that, if the vitamin A stores are high, no nutritional catastrophe is likely to develop if one misses his allowance of this dietary essential now and then.—Storage of vitamin A in the body. *Nutrition Rev.* 1: 176-177, April 1943.

EPIDEMIOLOGY OF STREPTOCOCCUS HEMOLYTICUS INFECTIONS AT NAVAL TRAINING STATIONS. I^{1,2}

ALVIN F. COBURN

Lieutenant Commander (MC) U. S. N. R.

Essential both to an understanding of the rheumatic problem and also to the care of the rheumatic subject is a full appreciation of the close association between hemolytic streptococcal infection of the upper respiratory tract and activation of the rheumatic process. This relationship is especially striking among the armed forces where rheumatic fever is prone to occur in explosive outbreaks following seasonal epidemics of streptococcal infections, and where at other times this disease appears only sporadically. Prerequisite to the prevention of rheumatic fever is the elimination of streptococcal epidemics. Although this goal may be difficult to attain under present conditions, measures can be employed to minimize the spread of *Streptococcus hemolyticus*. A full recognition of the severity of the sequelae that occur with the spreading of this respiratory pathogen should emphasize the importance of using all available methods to prevent outbreaks of streptococcal diseases in the armed forces. The purpose of this paper is to indicate the significance of streptococcal infections among young recruits and to present clinical observations made in the rheumatic fever ward of the Brooklyn Naval Hospital.

FACTORS IN TRAINING CENTERS CONDUCTIVE TO STREPTOCOCCAL EPIDEMICS

Five environmental conditions favoring the development of a streptococcal epidemic are frequently satisfied at a *training station in time of war*. An understanding of these conditions may serve in helping prevent the epidemic spread of this micro-organism and subsequent outbreaks of rheumatic fever. These conditions are: (1) Susceptibility of the host to infection by *Streptococcus hemolyticus*; (2) high rate of change of population; (3) overcrowding; (4) widespread activity of a respiratory virus, such as that giving rise to the "common cold," influenza or measles; (5) the presence of one or more strains of hemolytic streptococcus endowed with great communicability. The relation of these five factors to the spreading of upper respiratory tract

¹ Received for publication December 22, 1942.

² This is the first of three articles by Dr. Coburn on aspects of rheumatic fever. Bibliography and comment will follow the closing article.—*Editor*.

infections in a training center will be considered before the problem of rheumatic fever is discussed.

(1) Probably no human subjects have a natural immunity to group-A hemolytic streptococcus and it is unlikely that man acquires a permanent, effective immunity to any one of the more than 30 types of hemolytic streptococcus group-A.^{*} (1) There does seem, however, to be a difference in the degree of human susceptibility to this micro-organism. Particularly susceptible are those individuals who have lived in environments where exposure to streptococcal respiratory infections is minimal. This has been observed by the author working with inhabitants of Caribbean islands who had recently migrated to New York City, and it has also been noted that, in the armed forces, young recruits commonly contract their first recognized streptococcal throat infection during their initial winter in a cold climate. These hosts coming from isolated communities with little exposure to hemolytic streptococcus appear highly susceptible to infection. This fact must be recognized, although under the rigors of training for war it may not be possible to increase the general resistance of personnel in a training center.

(2) When a respiratory epidemic occurs in a training center it has been common experience that the incidence of infections is highest among the new arrivals and lowest among those completing training. Dudley (1) in his excellent monograph has pointed this out and emphasized the importance of a changing population in the development of outbreaks of respiratory diseases as follows:

The incidence of infectious disease will be proportional to some function of the rate of change of population. Therefore, other things being equal, in those communities where the number of inhabitants remains practically constant, the relative incidence of disease will be inversely proportional to the average duration of residence, or some function of it.

Indoctrination and detachment occasion a rapid turn-over of personnel during wartime, introduce susceptibles, and favor the development of an epidemic. To prevent this, appropriate measures must be taken for separating new recruits from other personnel and isolation of all streptococcal respiratory infections with the same vigilance given to scarlet fever.

(3) Overcrowding, with poor ventilation and close contact between individuals is well recognized as being conducive to the spread of respiratory pathogens. Glover (2) has pointed out that the incidence of rheumatic fever among Naval recruits varied with the crowding of

^{*}It has been shown by many investigators that the immunity to scarlet fever is not an immunity to streptococcal infection but merely a loss of skin reactivity to erythrogenic, streptococcal toxin. The author has found that student nurses immunized with N. Y.-5 streptococcal toxin contracted more streptococcal throat infections than a control group; however the infected individuals, Dick negative to 20 skin test doses, failed to develop a rash.

sleeping accommodations. Although in a war emergency it may not be possible to allocate adequate space, the hazards entailed by overcrowding should be appreciated and avoided if possible with the methods now available. However, before this hazard can be overcome, it must be generally recognized that floor dust plays an important role in the spread of respiratory pathogens. The author (3) described a hospital epidemic caused by hemolytic streptococcus, type 12, in which:

It seemed that the probable mode of spread was by air-borne dust particles disseminated when the ward was swept each morning. Type 12 organisms from these patients had a striking capacity to colonize on the mucous membranes and dermis of both children and nurses.

Many investigators (4) (5) (6) (7) have clearly demonstrated that the air in hospital wards containing patients with tonsillitis, burns, or puerperal sepsis contains large numbers of hemolytic streptococci; that the organisms recovered are the same serological types obtained from the patients' infections and that the number of organisms in the air increases sharply following bed making and sweeping. One hundred and two million hemolytic streptococci were recovered from the air of a tonsillitis ward by Thomas (8) following one sweeping, and Van den Ende et al. (9) have demonstrated that hemolytic streptococcus in dust may retain its virulence for a period of 2 to 4 weeks. The evidence that respiratory infections are largely air-borne has been well presented in a recent review by Buchbinder (10).

Although there is strong evidence that floor dust is of great importance in cross-infection, measures to correct this hazard have been slow in developing. In England this problem is being attacked by the National Institute for Medical Research (11) and in America numerous investigators have shown the effectiveness of chemical vapors and ultraviolet light (12). The studies of Robertson (13) on propylene glycol are at present most promising. However, until more information is available on the use of these measures, control is limited to simple, practical methods for the reduction of air-borne respiratory pathogens in hospital wards and crowded dormitories. Such a method is the treatment of floors with spindle oil as described by Thomas (8). This medical officer in charge of a British laboratory has shown that the application of 1 gallon of spindle oil to 1,000 square feet of floor every 2 months markedly lowers the number of pathogens in the air and concluded that "the use of spindle oil on all ward floors would remove much of the danger of infection from this source."

(4) An increase in a micro-organism's capacity to spread often occurs concomitantly with an outbreak of virus infections. At least five of the proven streptococcal epidemics have followed outbreaks of diseases considered of virus causation. Glover and Griffith (14) ob-

served one streptococcal epidemic following the "common cold" and another following measles. Bradley (15) studied an epidemic which was preceded by measles and the "common cold". Coburn and Pauli (16) recorded a streptococcal epidemic which was initiated by the influenza virus. The "common cold", measles and bronchitis preceded the epidemic reported by Hobson (17).

The influence of a virus on the spread of streptococcus in a ferret colony has been recently demonstrated by Glover (18). This investigator showed that the initiation of group-C hemolytic streptococcal infections among these animals depended on a concurrent infection with influenza A virus. Normal ferrets and ferrets whose respiratory mucous membrane had been damaged with zinc-sulfate solution failed to develop streptococcal infections with the group-C organism; whereas combined influenza A virus and the group-C streptococcus invariably caused streptococcal infection in clean ferrets. When clean ferrets were brought into contact with doubly infected animals they contracted streptococcal infection; but the bacterium alone was incapable of inducing infection. These observations add experimental proof to the well-recognized clinical association of virus infections with the spread of streptococcus.

Careful attention must be paid to apparently minor nasopharyngitis during a respiratory epidemic of virus infections. By taking throat cultures on these patients the earliest cases of hemolytic streptococcal disease will be detected. Isolation of these individuals may prevent the spread of hemolytic streptococcus to epidemic proportions.

(5) It is recognized that occasionally a strain of hemolytic streptococcus acquires some function essential for it to establish itself upon the tissues of a new host. The nature of this function is unknown; its development is rapid and its disappearance usually occurs spontaneously within a few weeks in a closed colony. In an open colony, however, this capacity of the organism may persist and increase for months. The two factors which favor most such an increase in communicability are concomitant respiratory virus infections and the introduction of susceptible hosts into the environment. And in a training center young recruits, like children, are the hosts that permit the micro-organism to acquire the adaptive mechanisms essential to establishing itself upon a new and perhaps more resistant host.

The invaluable contribution of Griffith (19) to the serological classification of group-A organisms, has made it possible to demonstrate that a single, highly communicable strain of hemolytic streptococcus gives rise to an epidemic (3) while other prevalent strains may have little capacity to spread. The simple slide agglutination technic now available for typing (20) (21) makes it possible to recognize an epidemic strain. However, even when the epidemic strain is recognized,

the prevention of cross infections presents a difficult problem, for which the only available solution is chemoprophylaxis.

The author has been confronted with this problem in three civilian institutional outbreaks of throat infections caused by hemolytic streptococcus group-A. One outbreak was caused by type 26 with a concurrent influenza virus infection. This occurred in a closed colony, was explosive and involved nearly all members within a few weeks. Quarantine was enforced for three months. At the end of this period the colony was opened and although a number of patients carried type 26 for many months, no infections occurred. The other outbreaks of throat infections were caused by type 12 and 25 and took place in open colonies in which no virus infection appeared to be active. Each of these was a slowly spreading epidemic initiated by a patient who appeared innocuous. One epidemic was terminated by a tonsillectomy on the patient spreading contagion; the other continued until the individual disseminating the highly communicable micro-organism was removed from the environment. The conclusions drawn from these three epidemics and many outbreaks of streptococcal infections among large families in New York City are as follows:

(a) It was at first difficult to detect the individual spreading contagion because he was not acutely ill. Having recovered from a minor upper respiratory tract infection he had developed a sinusitis or bronchitis. For days or weeks this secondary infection appeared quiescent and no cross infections were observed. However when an exacerbation of respiratory symptoms occurred the individual spread contagion.

(b) Adults who were cross infected appeared capable, in some instances, of spreading contagion but mainly during the incubation period before infection was recognized clinically.

(c) During the acute illness of pharyngitis or following recovery, infected adults failed to spread contagion although they carried the epidemic strain in their throat flora for many months. Unlike the unsuspected individual with a persistent low-grade infection these apparent sources of contagion were usually harmless carriers.

(d) Sulfonamides given prophylactically in doses of three grams daily protected contacts. These drugs had little or no effect on the throat flora of the harmless carriers. The administration of this drug to a dangerous carrier for a few days was without permanent effect on the throat flora. Whether the administration of sulfonamides for several weeks will convert a dangerous carrier to a harmless one is being determined.⁴ A report on this investigation will be presented separately.

In summary, the author has observed two types of air-borne streptococcal epidemics in which a highly communicable micro-organism

⁴ The author has had the opportunity to observe a pneumococcus type 3 carrier who reinfects the upper right lobe about every 3 months. The patient carried this organism in the maxillary and ethmoidal sinuses and over a period of 5 years developed 19 attacks of pneumococcus type 3 pneumonia. An attempt to prevent further attacks with prophylactic doses of sulfanilamide, 3 grams daily, was ineffective; however the institution of sulfapyridine prophylaxis, 1.5 grams daily for 4 months in 1938 was followed by 2 years of good health. In 1940 she developed one more attack of pneumonia which, however, in this instance was associated with type 29.

gave rise to throat infections. The one associated with a virus factor demands early recognition and requires that strict isolation precautions be instituted. The other, associated with the spreading of contagion by a single individual, requires that the dangerous carrier be detected and removed from the environment and that the contacts be protected by prophylactic doses of sulfonamide.

That these five conditions obtain in a training station under war conditions was recognized during World War I. At that time it was observed that in a measles ward, the streptococcal carrier rate rose rapidly. Beginning with a carrier rate of 11.4 percent there was a rise to 38.4 percent in 5 days and 56.8 percent in 16 days. Excluding pneumonias, measles and diseases of probable streptococcal origin there were approximately 242,000 infections due to hemolytic streptococcus. This was an incidence of 7 percent of the mean annual strength of the armed forces among whom were recorded 56,000 cases of rheumatic fever or rheumatism (22). Outbreaks of rheumatic fever following streptococcal epidemics have already been observed in World War II in training centers in England (23) and America (24). It is clear that the problem of streptococcal epidemics with the subsequent development of rheumatic fever is of great importance and deserves most serious consideration.

HEMOLYTIC STREPTOCOCCAL INFECTION THE PRECIPITATING FACTOR IN RHEUMATIC FEVER

Studies conducted in England (2) and in America (25) have pointed out the close relationship between the subsidence of upper respiratory tract infections and the onset of rheumatic fever. These respiratory diseases have been shown by bacteriological studies to be manifestations of hemolytic streptococcal infection (26) (16). During the past decade the serological observations of many investigators have strengthened the concept that hemolytic streptococcus is the precipitating factor in rheumatic fever; however the exact mechanism by which the micro-organism initiates rheumatic activity is still not clearly understood. The present evidence indicates that hemolytic streptococcal infection of the pharynx is handled in an abnormal manner by certain individuals (27), i. e., rheumatic subjects; that the rheumatic process is probably associated with sensitization to an antigen derived in part at least from this microorganism (28) and that the mesodermal tissues of rheumatic subjects who have had poor diets during childhood are particularly vulnerable to this abnormal immune reaction (29). The collected evidence has been admirably summarized in a recent review by Green (30).

Sixty-five rheumatic patients admitted to the Brooklyn Naval Hospital in the spring months of 1942 were asked whether they had had a preceding respiratory infection. Fifty-two (80 percent) of these

had recovered from a recent infection which had subsided one to 3 weeks prior to the onset of rheumatic symptoms; 13 (20 percent) were unaware of a recent infection. The types of respiratory diseases experienced were diagnosed as follows: Tonsillitis, 28 cases; catarrhal fever, 10 cases; scarlet fever, 5 cases; and less severe infections classified by the patients as "bad cold" in 6; "grippe" in 2 and "sinusitis" in 1 patient. The Naval activities where the infections were contracted were mostly in the Third Naval District. Only three patients developed rheumatic fever at sea and only one of these had been at sea for two weeks when symptoms commenced. These 52 patients were stationed at the following Activities:

Naval activity:	<i>Number of cases</i>
Receiving Ship, N. Y.-----	21
Brooklyn Naval Hospital-----	10
Navy Yard or Receiving Barracks, Brooklyn-----	6
Norfolk, Va-----	4
Receiving Ship, Chicago-----	3
Receiving Ship, Philadelphia-----	2
Several other activities, each-----	1

Facilities for studying the throat flora during the respiratory infections were not available. Throat cultures were made during the rheumatic attack in only eight of these patients, five of whom still carried group A hemolytic streptococcus, serologically identified as types 19 and 30.

In many instances the clinical epidemiologist had difficulty in determining whether a respiratory infection was contracted on a Naval activity or on liberty. In some instances, however, it was possible to ascribe the infection to a particular activity.



VITAMIN SYNTHESIS BY INTESTINAL BACTERIA

Intestinal bacteria are apparently of much greater importance to animal nutrition than was formerly suspected. It is recognized that vitamin K is synthesized by bacteria in the intestinal tract of man and most animals in quantities sufficient to meet their needs. Intestinal organisms isolated from man have been shown to synthesize thiamine, riboflavin, niacin, and biotin.

Recent experiments further suggest that intestinal bacteria may synthesize B-vitamins that have not been clearly identified.

It is evident that if intestinal bacteria do synthesize essential food substances which previously have not been recognized, then these factors should be present in the feces of animals as well as in liver or yeast.—Vitamin synthesis by intestinal bacteria. *Nutrition Rev.* 1: 175-176, April 1943.

RHEUMATIC FEVER IN THE NAVY¹

ARTHUR M. MASTER
Commander (MC) U. S. N. R.

The remarks to be made in this report are the results of a survey made of war casualties at the United States naval hospitals at Oakland, Treasure Island, Mare Island, and San Diego in December 1942.

Eighty cases altogether were reviewed. The diagnoses were clear-cut. Acute migrating polyarthrititis was present, with fever, leukocytosis, increased sedimentation rate, and usually electrocardiographic changes. The ages ranged between 17 and 25 years, with the exception of three patients of 30, 31, and 43 years, respectively. The average age was 21 years.

Most frequently the current attacks occurred in the winter and spring months following an upper respiratory infection associated with physical exertion, fatigue, and often with mental strain. The boys came from the west-coast training camps, from the South Pacific, from ships on which they had stood watch, from ships that were sunk, and from the Solomons. Some of the patients had suffered from prolonged immersion. Others had experienced severe ordeals on Guadalcanal. With the unaccustomed physical strain, there had been concentrations of a large number of men. Exposure to the elements, with rain and high humidity, with no adequate protection, were stories often obtained. The attacks often took place a few days to a few weeks after enlistment.

The episodes of acute rheumatic fever were of the textbook variety, so that there is no necessity for going into detail as to their symptoms and signs. There is a threefold reason for reporting these instances of rheumatic fever in our young sailors and marines. The first is to emphasize a fact which is well known to the Medical Corps of the Navy, especially to the epidemiologists, namely, that rheumatic fever is a real problem. Epidemics (1) have occurred at the Newport and Great Lakes Training Stations and sporadic cases are present in all the training camps and hospitals. The problem of preventing rheumatic fever in the Navy is being delved into energetically.

The second reason for this report is to make the point that rheumatic fever has appeared among our marines and sailors in the tropics. At the United States naval hospital at Oakland, Calif., alone, there were nine cases which developed in the South Pacific. Some of the patients

¹ Received for publication January 28, 1943.

were marines from the Solomons, while others were picked up from the water after their ships had been sunk. The writer has always been of the opinion that rheumatic fever occurs in the tropics, perhaps in a somewhat different form from that which we are accustomed to see in this country. Swift (2) has pointed out that recent reports indicate the presence of rheumatic heart disease in tropical regions. The existence of rheumatic heart disease presupposes the existence of acute rheumatic fever.

The third and final point of interest is the fact that in 54 percent of the cases a past history of one or more attacks of childhood rheumatic fever has been obtained. It would seem probable that the incidence is even higher, considering the fact that so often there is no time for an adequate history when there is a large influx of casualties, and that often under "past history" a statement is merely made that it is negative, or not relevant. In other words, the men with rheumatic fever have probably had this disease in childhood, and exposure to inclement weather, physical exertion, fatigue, crowding, or upper respiratory infection has precipitated another attack. This simply is evidence for the view already held by many (3) that rheumatic fever is a continuous chronic disease with recrudescences. The respiratory infections most likely to precipitate rheumatic fever attacks are due to a specific strain of streptococcus.

The 54 percent incidence of a history of a childhood attack of acute rheumatic fever in our 80 patients on the west coast is probably not too high. Hedley (4) found that the first attack of rheumatic fever in at least 70 percent of the cases occurred between the ages of 5 and 9 years. Cohn and Lingg (5) have just made a statistical study of "The Natural History of Rheumatic Cardiac Disease," in which they state that "rheumatic fever may begin at any age, but it begins more often at about 8 years than at any other age. At 15, 70 percent of persons afflicted have already acquired the disease."

Dr. T. Duckett Jones, of Boston, in a study for the Navy of the cases of rheumatic fever which occurred in the Newport Training Station, recently found that 31 percent, nearly a third of the patients, gave a history of a previous attack of rheumatic fever in childhood. It should be remembered that patients often do not recall acute articular rheumatism (4); even the parents frequently do not. Many an instance is met of a patient with a negative past history, but possessing a large heart with significant murmurs indicating previous heart disease. To strengthen further the significance of our 54-percent incidence of a past history of one or more attacks of rheumatic fever in early childhood, is the fact that in a control series of 423 cases there were only 8 who had suffered from rheumatic fever in childhood, representing a 2-percent incidence in the controls. These control cases were observed in the same hospitals in which the rheumatic fever

patients were or had been present. They were patients of similar age groups and were generally the surgical cases, gunshot wounds, burns, amputations, appendectomies, herniotomies, etc. The histories on these controls were obtained with great care and with the complete cooperation of an unusually intelligent group.

In this connection I might mention that I saw 10 patients in the west coast naval hospitals with definite chronic cardiac valvular disease whose murmurs had been missed on enlistment. Five of these gave authentic histories of rheumatic fever in childhood. This is suggestive reasoning again that all adult patients with rheumatic fever have had the disease in early life, and also a bit of circumstantial evidence that once a boy has had rheumatic fever he should not be acceptable for service in the Navy.

It appears that the congestion among recruits living at training stations and elsewhere, the rapid turn-over of men, the stress and strain, physical and mental, undergone in wartime even in the training camps of our country, causes a recrudescence or exacerbation of the latent rheumatic disease. This is the medical implication for the Navy. Whether or not this can be applied to the selection of recruits remains to be seen. The number of applicants for enlistment who must be examined every day does not allow time for taking detailed case histories in the recruiting stations. Furthermore, it is probable that the average young man who volunteers for enlistment would probably not admit to past rheumatic fever if such a history were known to be disqualifying. Such histories might be obtained during the examination in the training stations after enlistment, before the recruit entered general service. It might be feasible, however, to include authentic past history of rheumatic fever as a disqualifying defect for induction under Selective Service.

In conclusion, it would seem that just as in tuberculosis, once the recruit gives a previous history of rheumatic fever he should not be accepted in the armed forces of the country, and once he develops rheumatic fever while in service he should not be retained.

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NEW DEVELOPMENTS IN THE TREATMENT OF PROSTATIC CARCINOMA ¹

MARK S. CURTIS

Lieutenant Commander (MC) U. S. N.

During the past 2 years, a new type of treatment for carcinoma of the prostate gland has been developed. Sufficient time has not yet elapsed to evaluate it from the standpoint of cures, but all evidence to date points to the fact that it offers a high degree of symptomatic relief. This new treatment employs the removal of the stimulation to the neoplastic tissue, both in its primary and metastatic sites, by the male androgenic hormone. This may be accomplished by: First, removing the source of the hormone (by bilateral orchidectomy); or, second, neutralizing the hormone, or its effects in the body (by the administration of estrogenic substances). There is also evidence suggesting that irradiation of the testicles, by rendering them incapable of producing the hormone, may be of benefit in the treatment of this disease (1).

Research in recent years has also brought to light certain other facts with a direct bearing on the problem of prostatic carcinoma; these deal with the relationship between the so-called serum "acid" phosphatase and prostatic carcinoma. Since this work antedates that mentioned above, a brief discussion of it here is not out of place.

REVIEW OF THE LITERATURE

Serum "acid" phosphatase and its relationship to prostatic carcinoma.—In both plants and animals, phosphatases are present which catalyze the splitting off of phosphoric acid from certain organic esters. These may be classified provisionally into two groups—"alkaline" phosphatase and "acid" phosphatase—because of their property of manifesting their optimum activity in alkaline or acid environment (2).

In 1935 it was found that normal adult prostatic tissue contains a very high concentration of a phosphatase which manifests its optimum activity between pH 4.5 and 6.0 (3). It is an interesting fact that until puberty the prostatic tissue of man contains only insignificant amounts of this enzyme, which is apparently elaborated by the prostatic epithelium. A technic for the microscopic demonstration of this substance in tissues has been evolved (4).

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This enzyme is also found in the blood serum of the adult human. Both in the blood serum and in other body fluids, as well as in the tissues, it can be quantitatively determined by the method of King and Armstrong. The blood serum of normal adult humans contains 4.0 or less King-Armstrong units of this substance per 100 cc. of blood.

Work done in 1936 showed that this enzyme is present in large amounts in carcinomatous prostatic tissue, both at the primary site and at metastatic sites (5). It was then found that the majority of patients with carcinoma of the prostate metastasizing to bone have significantly elevated levels of this substance in their blood sera (2) (6). By means of repeated determinations of serum "acid" phosphatase, Robinson, Gutman, and Gutman (7) came to the conclusion that a rise in these levels may signify further metastatic involvement. As yet no definite relationship between the height of the levels and the extent of the metastatic involvement has been established.

Normal levels of serum "acid" phosphatase have been found in all pathological conditions of the prostate other than carcinoma metastasizing to bone. These include cases of carcinoma without skeletal metastases, prostatitis, benign hypertrophy, and lymphosarcoma. In cases of prostatic carcinoma with elevated levels of this enzyme, but in which x-ray studies do not definitely show skeletal metastases, it has been found that definite x-ray evidence of such metastases is likely to develop subsequently (2).

In diseases other than those affecting the prostate gland, including numerous types of cancer, with and without osseous involvement, elevated levels of serum "acid" phosphatase have been rarely found (2) (7). By virtue of these facts, one is able to establish in a case with metastases of unknown origin, particularly to the skeletal system, whether or not the primary lesion is in the prostate.

An exception to this is far advanced osteitis deformans (Paget's disease of bone), in which elevations of serum "acid" phosphatase are occasionally found. Cases of early and moderately advanced osteitis deformans have consistently shown normal levels. This is important, because the differential diagnosis by x-ray between bony metastases from prostatic carcinoma and early osteitis deformans is sometimes extremely difficult, particularly in those cases in which palpation and biopsy of the prostate give equivocal results. The fact that certain cases of far-advanced osteitis deformans show elevated levels of this enzyme does not detract from the value of this aid to differential diagnosis, since in these advanced cases extremely high levels of serum "alkaline" phosphatase (a phosphatase found in human serum which manifests its maximum activity at a pH of 8.5 to 9.0) are also found. Moderate elevations in serum "alkaline" phosphatase are occasionally found in cases of disseminated carcinoma of the prostate, but these never reach the high levels found in far-advanced osteitis deformans.

(2) (8). Then, too, the x-ray findings of far-advanced osteitis deformans are almost always characteristic enough to allow of a definite diagnosis.

Certain cases of carcinoma of the prostate with bony metastases will have normal levels of serum "acid" phosphatase; but in all cases having 10 or more King-Armstrong units, osseous involvement will be found (9).

The effects of castration, estrogen therapy, and the administration of androgen upon the levels of serum "acid" phosphatase in patients with disseminated carcinoma of the prostate have been studied (2) (9) (10). In the majority of cases with elevated levels, castration and estrogen administration, cause a marked fall, while the administration of androgen causes a marked rise in these levels. Sullivan (6) has utilized this latter fact in devising a provocative test for cases of prostatic carcinoma showing equivocal x-ray evidence of metastases and border-line serum "acid" phosphatase levels. He advises the use of 25 mg. of testosterone daily for 5 days; and in cases with metastases, a detectable rise in the level of serum "acid" phosphatase will occur. However, care must be exercised in this test, as it has been found that androgen administration can cause a marked increase in the symptoms of these patients (10).

While much work remains to be done before the relationship of serum "acid" phosphatase to prostatic carcinoma is fully understood, the facts thus far adduced are of great clinical help in the following respects:

1. As a means of definitely establishing the diagnosis in cases of suspected carcinoma of the prostate with bony metastases.
2. In the selection of therapy in prostatic carcinoma; i. e., the absence of metastases warrants an attempt at total eradication of the disease by total perineal prostatectomy, whereas the presence of metastases indicates the employment of hormonal therapy (castration, estrogen administration) and the relief of urinary obstruction (transurethral resection) only.
3. In determining whether skeletal metastases are of prostatic or nonprostatic origin in cases where such metastases are present but the site of the primary lesion is unknown.
4. In differentiating between disseminated prostatic carcinoma and early or moderately advanced osteitis deformans.
5. As an index to recurrence following prostatectomy or to the progression of metastases, and hence of value in guiding and evaluating the therapy employed.

Treatment of prostatic carcinoma by castration.—Castration, as a form of treatment for disease of the prostate gland, is not new. In the latter part of the nineteenth century, it was employed for benign hypertrophy, and several workers reported beneficial results therefrom (11) (12). As late as 1940, the effects of castration on the epithelium of the hypertrophied prostate were studied, and it was found that the epithelium became atrophic in a relatively short time following the operation (13).

On the assumption that prostatic carcinoma is often, if not always, composed of adult tissue, as evinced by the high "acid" phosphatase content of both normal and carcinomatous prostatic tissue, and in view of the known fact that castration causes regression of adult prostatic tissue, Huggins and his co-workers, in 1940-41, castrated 21 patients with far-advanced or metastatic (skeletal) carcinoma of the prostate gland (14). Of these, 4 died within 8 months after the operation, and 2 were not followed long enough postoperatively to allow conclusions to be drawn. The remaining 15 showed appreciable clinical improvement, as evidenced by marked diminution of pain, increase in body weight, red-blood cell count, and appetite, shrinkage of the primary lesion, and increased density of the metastatic bony lesions in the x-rays.

Subsequent to the publications of Huggins, et al., there have appeared in the literature other reports showing equally encouraging results from this method of treatment.

By-effects from castration have been reported to be surprisingly infrequent; these include genital atrophy, hot flushes, and abolition of sexual ability. The hot flushes can be controlled by estrogen administration (14).

Estrogen therapy of prostatic carcinoma.—The reports in the literature on the results of treatment of prostatic carcinoma by the administration of estrogenic substances are as encouraging as those dealing with the castration therapy of this disease (15) (16) (17) (18). The estrogenic substances have been given both orally and intramuscularly, in doses varying from 1 mg. weekly to 3 mg. daily. It has been found that the optimum dose of the drug must be determined individually for each patient, as too great an amount produces gastric irritation and transient gynecomastia. The point at which these by-effects manifest themselves varies considerably in different patients. As yet, no lasting organic damage to any organ has been demonstrated as a result of this therapy with the exception of moderate genital atrophy, which is seen frequently in these patients.

The effects of estrogen therapy upon the histology of prostatic carcinoma have been studied, and these investigations have shown that definite regressive changes in the nuclei and cytoplasm of the tumor cells occur (19) (20).

It has been found that some patients with disseminated carcinoma of the prostate will show no benefit, or only fleeting benefit, following castration. This, it is believed, is due to the existence of extragenital sources of androgen, notably the adrenal cortex (10). It is hoped that estrogen administration in these cases will prove of benefit; however, in the present series disappointing results were obtained in the very small number thus treated.

Satterthwaite (21) and his co-workers studied the effect of castration upon the urinary output of androgenic substances (the 17 ketosteroids) in cases of carcinoma of the prostate. They found that the degree of clinical improvement is closely correlated with the percentage decrease in the urinary output of these substances; i. e., in cases showing a marked decrease in urinary output considerable improvement can be expected, and in cases showing little or no percentage decrease the reverse is to be expected. They feel that in these latter cases estrogen therapy is indicated. The precastration levels of these substances were found to be within the normal range for elderly men. Hence are of no value diagnostically.

REVIEW OF CASES

The present series consists of 27 cases of carcinoma of the prostate in which bilateral orchidectomies were performed at the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital between July 1941 and June 1942. In 23 of these the pathological reports showed carcinoma of the prostate. In 2 of the remaining cases, there were no pathological reports, as the patients had neither operation on the prostate nor biopsy, and in the other 2 the pathological reports showed disease other than carcinoma of the prostate; one of the former and both of the latter patients have demonstrable skeletal metastases, and the clinical pictures of all 4 are sufficiently typical to warrant a definite diagnosis of prostatic carcinoma.

Four of the twenty-seven patients died too short a time after castration to permit an evaluation of the results of the castration therapy.

In these cases, three methods of castration were employed (table 1):

1. The guillotine method, in which the spermatic cord is divided in the upper or middle part of the scrotum and ligated with transfixion sutures, thus removing the testicle and epididymis as well as a portion of the spermatic cord.

2. The method in which the testicle is carefully dissected away from the epididymis, leaving the latter and all of the spermatic cord.

3. The method suggested by Hess, in which the tunica albuginea is incised and the testicle shelled out, the tunica then being replaced in the scrotum. This third method leaves the tunica albuginea, epididymis, and spermatic cord in the scrotum.

Of the three, the guillotine method is technically the simplest and is the procedure of choice in patients who are extremely poor operative risks, particularly when local anesthesia is indicated. However, it has the disadvantage of leaving a practically empty scrotum, which in some patients has a markedly bad psychological effect. Since the results following castration have been the same for the three methods, it is felt that unless contraindicated by the patient's condition one of

the two latter methods should be employed. That suggested by Hess is the one of choice, as it leaves more tissue in the scrotum and is technically easier than separating the testicle from the epididymis.

TABLE 1.—*Types of orchidectomy employed*

Method:	Cases
Guillotine method.....	6
Separation of testicle from epididymis.....	13
Method of Hess.....	7
Combination of guillotine and Hess methods.....	1

TABLE 2.—*Types of prostatic operations*

Operation:	Cases
No prostatic operation.....	2
Transurethral resection (15 patients).....	18
Radical perineal prostatectomy.....	6
Transurethral resection with radon implantation.....	1
Radical perineal prostatectomy with radon implantation.....	1
Subtotal perineal prostatectomy.....	1
Suprapubic prostatectomy.....	1

Of the 27 patients in this series, 25 had prostatic operations, the majority being transurethral resections for the relief of urinary obstruction (18 resections on 15 patients). Six patients had radical perineal prostatectomies, 1 had transurethral resection with radon implantation, 1 radical perineal prostatectomy with radon implantation, 1 subtotal perineal prostatectomy, and 1 suprapubic prostatectomy. This latter patient had his prostatic operation in May 1939, and bilateral orchidectomy was done in March 1942 because of extensive local recurrence. He did quite well for 6 months following castration, but in September 1942 it was found that he had developed bony metastases in his right ilium and lumbar vertebrae. He has since been receiving stilbestrol therapy, with moderate clinical improvement.

Effect of castration on recurrence of primary lesion.—Follow-up rectal examinations were done on all patients who had prostatectomies, with the exception of one who died 5 weeks following radical perineal prostatectomy with radon implantation; the results of these are shown in table 3.

TABLE 3.—*Recurrences at primary site following prostatectomy and castration*

	Cases
Radical perineal prostatectomy.....	6
No evidence of recurrence (67 percent).....	4
Questionable evidence of recurrence (17 percent).....	1
Definite evidence of recurrence (17 percent).....	1
Subtotal perineal prostatectomy (with no evidence of recurrence).....	1
Suprapubic prostatectomy (with evidence of massive local recurrence).....	1

Effects of castration on skeletal metastases.—Skeletal x-rays were taken prior to castration in 23 of the 27 cases; the findings of these are summarized in table 4.

TABLE 4.—*Findings of precastration skeletal X-rays*

Findings:	Cases
Definite evidence of metastases.....	10
Questionable evidence of metastases.....	5
No evidence of metastases.....	8
Precastration x-rays not taken.....	4

Postcastration x-rays were taken in 8 of the 10 cases that prior to castration showed definite evidence of bony metastases, and in 4 of the 5 cases that showed questionable evidence of such metastases. (Two patients showing definite, and 1 patient showing questionable, evidence of skeletal metastases before castration died during the course of this study, hence no postoperative x-rays were taken.) The effects of castration on these skeletal lesions are best seen by a study of table 5.

TABLE 5.—*Effects of castration on definite and questionable precastration skeletal metastases*

Cases showing definite bony metastases:	Cases	Percent
Definitely improved.....	3	38
Definite progression.....	4	50
No demonstrable change.....	1	12
Cases showing questionable bony metastases:		
Developed definite metastases.....	1	25
Did not develop metastases.....	3	75

Effects of castration on serum "acid" phosphatase levels.—Precastration studies on the serum "acid" phosphatase levels were done in 25 of the cases. The results of these are shown in table 6.

Studies were also made to determine the postcastration serum "acid" phosphatase levels and the correlation of these to the progression or regression of skeletal metastases.

In neither of the two cases having normal serum "acid" phosphatase levels and x-rays negative for skeletal metastases before castration did metastases or elevations in the serum "acid" phosphatase levels develop following castration.

In all four cases showing elevated levels of the enzyme, but with negative skeletal x-rays prior to castration, the enzyme levels fell to normal immediately following castration; two of these remained normal, while the other two became elevated later. No metastases developed in the former two, while in the latter two skeletal metastases developed coincident with the secondary rise in the serum "acid" phosphatase levels.

Of the two patients with border-line levels of the enzyme and negative skeletal x-rays before castration, one died, while the other now has a normal enzyme level and no x-ray evidence of skeletal metastases.

There were 7 patients in the series with elevated levels of serum "acid" phosphatase and demonstrable skeletal metastases before castration. The enzyme level of one fell to normal and has remained within

normal limits to date. It is regrettable that this patient had no follow-up skeletal x-rays, but when last seen he had clinical evidence highly suggestive of regression of his metastases. The enzyme of another

TABLE 6.—*Precastration studies on serum "acid" phosphatase*

	Cases	Percent
Cases with demonstrable skeletal metastases-----	9	
Normal levels-----	1	11
Elevated levels-----	7	78
Border-line levels (more than 4.0 but less than 6.0 King-Arm- strong units)-----	1	11
Cases without demonstrable skeletal metastases-----	8	
Normal levels-----	2	25
Elevated levels-----	4	50
Border-line levels-----	2	25
Cases with questionable skeletal metastases-----	5	
Normal levels-----	2	40
Elevated levels-----	3	60
Cases without precastration skeletal x-rays-----	3	
Normal levels-----	2	67
Elevated levels-----	1	33

fell from a precastration level of 15 King-Armstrong units to 7 units following castration. His metastases have increased in extent in spite of this fall. Three others in this category had their serum "acid" phosphatase levels return to normal following castration and then show a secondary rise to abnormal values. Two of these show extension, the third regression, of metastases. In the remaining two cases death ensued too early for a follow-up to be made.

The one patient with skeletal metastases and normal serum "acid" phosphatase levels prior to castration has repeatedly shown normal levels since castration; however, his metastases have increased in extent. It appears, therefore, that normal serum "acid" phosphatase levels do not always rule out the extension of metastases.

There were five patients with questionable evidence of skeletal metastases prior to castration; two had normal and three had elevated serum "acid" phosphatase levels. The levels of the first two have remained normal; those of the other three have fallen to and remained normal. In none of these cases were skeletal metastases seen by x-ray following orchidectomy.

From the foregoing it is apparent that a majority of patients having prostatic carcinoma metastasizing to bone will show elevated levels of serum "acid" phosphatase (77 percent in this series). The diagnostic value of this is obvious. In two of the four cases without demonstrable bony metastases but with elevated levels of serum "acid" phosphatase prior to castration, metastases developed postoperatively; while in neither of the two cases with normal enzyme levels before castration did metastases develop postoperatively. These determinations are, therefore, also of great value in prognosticating metastatic extension at some future date. Following castration, if repeatedly normal levels of the enzyme are found, the development or extension of skeletal metastases is doubtful; whereas should elevated levels be found, the reverse is likely to be true.

The effects of castration on the primary lesion.—The effects of castration on the size and consistency of the prostate glands were studied in patients who did not have prostatectomies. Fifteen cases were thus followed. Three patients in this category died during the course of the study, hence are not included. Eight of the fifteen (53 percent) showed marked decrease in both the size and consistency of the prostate, 5 (33 percent) slight decrease in size and consistency, 1 (7 percent) decreased consistency but no change in size, and 1 (7 percent) no change in either size or consistency. Only 1 of the 15 patients, therefore, failed to show any change suggestive of regression of the malignant process in the prostate gland postoperatively, and over half (53 percent) showed quite marked changes.

The effects of castration on pain.—Eleven patients in this series complained of pain before castration. In all of these cases the pain was severe, and in three it was sufficient to incapacitate the patients. Following castration, the pain disappeared completely in six cases (55 percent), was markedly decreased in two (18 percent), was moderately decreased in one (9 percent), and became worse in two (18 percent). In both of these last cases the pain decreased for a time after castration, but became worse later, coincident with extension of skeletal metastases.

The relief of pain was frequently little short of startling, many of the patients having marked decrease or complete disappearance of their pain within 24 to 48 hours after castration. As is customary with all types of patients, coincident with the lessening or abolition of their pain, these patients showed rapid improvement, physically and psychologically.

The effect of castration on the patient's sense of well-being.—Due to the 4 deaths, only 23 patients were checked as to their sense of well-being. In this respect, as with the alleviation of pain, the results were often startling. Of the 23, 19 (83 percent) showed marked, and 3 (13 percent) showed moderate, improvement, while only 1

(4 percent) felt worse following castration. This last patient improved for 6 months postoperatively but has felt poorly during the past 2 months and is slipping fast. All of the other patients—even those showing extension of their metastases—are quite pleased with the results they have obtained in this respect following castration.

The psychological effect on this group of patients can hardly be appreciated without seeing and talking to them; in some it borders on euphoria. Practically all of them report a marked increase in appetite and in their enjoyment of food. This is even more encouraging when one considers that most of these patients were in poor physical and psychological condition prior to their surgery.

The effects of castration on urinary symptoms.—As might be expected, a very high percentage of the patients (26 out of 27) had complaints referable to urination prior to castration, the most common being nocturia, frequency, difficulty in starting and maintaining the urinary stream, and dysuria. Omitting the 4 patients who died during this study, 22 patients from this group were followed; of these, 13 (59 percent) have no urinary symptoms, 8 (36 percent) report a decrease in symptoms, and 1 (5 percent) shows no change. The fact that all but one had prostatic operations must be borne in mind in evaluating these results. However, it is felt that such excellent results are not entirely attributable to this surgery. Indeed, when the effects of castration on the size and consistency of the malignant process in the prostate glands of these patients is borne in mind, the decrease in urinary symptoms is not surprising.

Effects of castration on body weight.—Of the 23 patients who were alive at the termination of this study, 19 (84 percent) showed gains in body weight, while the weight of 2 (8 percent) remained unchanged, and 2 (8 percent) showed a loss in weight. The gains were all more than 8 pounds, most of them being from 15 to 20 pounds. One patient reported a gain of 30 pounds. The gain in weight was apparent upon cursory examination of these patients and was particularly noticeable as so many of them had been emaciated prior to operation.

By-effects of castration therapy.—By-effects of castration therapy were conspicuous by their absence in this series. A few patients noticed slight to moderate genital atrophy, but all stated that they felt that the benefits obtained far overshadowed this. No other by-effects attributable to orchidectomy were encountered. The loss of their testicles did not seem to bother these patients, which is not too surprising when one considers the age group represented. Here, again, all of them stated that this loss was more than compensated for by the beneficial results obtained from the procedure.

Stilbestrol therapy.—Four patients were given stilbestrol therapy, three of them because of the extension, and one because of the development, of skeletal metastases subsequent to orchidectomy. The results

in three of these cases have been disappointing; all showed rather definite improvement when the therapy was first instituted, but all are now going downhill and are bedridden. The fourth patient has been on this therapy for only 3 months and has shown moderate improvement to date, but it is too early as yet to evaluate the results in this case.

Dosage of the drug ranged from 1.5 to 5.0 mg. orally per day. When doses of 5.0 mg. daily were given, the patients all complained of rather severe anorexia, nausea, vomiting, hot flushes, and nervousness. These by-effects ceased when the dose was reduced to 1.25 to 2.5 mg. daily, depending on the tolerance of the patient. From the experience gained in this very small series, it is felt that if stilbestrol therapy is to be employed the dosage must be fitted to the patient's individual tolerance in order to prevent untoward by-effects.

It should be emphasized that the poor results obtained in this series of cases with this drug were all in patients in whom orchidectomy had failed. Reports in the literature have shown very encouraging results following its use instead of castration in patients with carcinoma of the prostate. It therefore appears to have a very definite place in the therapy of this disease, particularly in those patients who refuse castration or who are considered too poor operative risks for even the guillotine method of orchidectomy under local anesthesia.

Analysis of the deaths.—Of the four deaths that occurred in this series, only one is known to have resulted directly from the prostatic neoplasm. This patient had widespread skeletal metastases to his spine, ribs, and pelvis on admission. He went steadily downhill and died 1 month after having had transurethral resection and bilateral orchidectomy. He did not obtain even fleeting improvement from his castration. Another patient died of unknown causes 2 months following castration and radical perineal prostatectomy with implantation of radon; he also had extensive skeletal metastases, and it is probable that his death was due in large part to his prostatic carcinoma. A third patient died of pulmonary embolism and cardiac failure 3 days after castration and transurethral resection; while the fourth died of "carcinoma of the liver" 5 months after castration. This last patient died elsewhere and no autopsy report was available, but it is quite possible that his "carcinoma of the liver" may have been a metastasis from his prostatic cancer.

COMMENT

The author fully realizes that the period of follow-up in the above cases has been too short to allow an evaluation as to the number of cures, if any, that may be expected from the castration treatment of prostatic carcinoma. However, it appears to be established: (1) That by proper evaluation of precastration and postcastration

levels of serum "acid" phosphatase, the presence or absence, and regression or extension, of skeletal metastases may be adduced quite accurately, although no correlation between the height of these levels and the extent of the skeletal metastases present has as yet been found; and (2) that a marked degree of symptomatic relief and clinical improvement will occur, for a time at least, in a large enough percentage of cases thus treated to make this type of therapy extremely worth while. (This is true in patients who have widespread metastases and even in some who appear moribund.)

Orchidectomy, it must be borne in mind, in no way supplants other indicated surgical procedures in the treatment of prostatic carcinoma, but should be used, in the majority of instances, as a supplement to these. The ideal treatment of any cancer is its complete removal; in those too few cases in which the diagnosis is made before the malignant process has extended beyond the prostate gland itself, this can only be accomplished, in the light of our present knowledge, by total perineal prostatectomy. It is only by doing careful periodical rectal examinations on all men over 40 years of age, and thus diagnosing a greater number of cases of this insidious disease in its early, or entirely localized, stage, that we can hope to increase the number of cases in which complete surgical extirpation is possible of accomplishment. The fallacy of castrating a patient to secure regression of skeletal metastases from carcinoma of the prostate, and in the meantime of letting him die of uremia due to bladder neck obstruction that could have been relieved by transurethral resection, is evident.

SUMMARY

1. A review of the literature on the hormonal therapy of prostatic carcinoma, and of serum "acid" phosphatase and its relationship to this disease, is presented.

2. The results obtained in a series of 27 cases of prostatic carcinoma treated by castration are also presented.

3. Serum "acid" phosphatase levels, both before and after castration, are extremely valuable in the detection and evaluation of subsequent behavior of skeletal metastases from carcinoma of the prostate.

4. Regression of skeletal metastases occurred in three out of eight cases (38 percent) in the present series.

5. Changes suggestive of regression of the malignant process in the prostate gland occurred in 14 out of 15 (93 percent) of the cases studied. These were manifested by a decrease in the size or consistency of the gland, or of both.

6. A marked degree of symptomatic relief and clinical improvement can be anticipated in a high percentage of cases thus treated, as manifested by the abolition or diminution of pain and urinary symptoms.

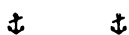
improvement in the sense of general well-being, and gains in body weight and appetite.

Acknowledgment.—The author wishes to express his gratitude to Dr. O. S. Lowaley, Director, and other members of the staff of the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital for the helpful suggestions and assistance they have given him in the preparation of this paper.

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AVOIDANCE OF ARTEFACTS IN PHOTOROENTGENOGRAPHY

Cassettes.—Only metallic cassettes specially manufactured for photoroentgenographic purposes should be used. The ordinary 35-mm. cassette that is satisfactory for photography is too fragile. If used repeatedly, it will soon allow light to seep in and blacken the film.

Film reel.—The 250-exposure film reel now in use has a slit in which the film is inserted to start it going. This slit permits the leakage of light and produces a characteristic artefact. The latter is a thin, horizontal band of black which may cross the film at any point. To prevent this artefact, the reel should be covered with a piece of black paper fastened by scotch tape. The end of the film should then be attached to the reel by another piece of scotch tape so that the film will not slip.

A new reel without a slit is now being constructed so that this artefact will soon be eliminated.

Camera.—(a). In some instances the region where the lens connects with the camera has been a source of light seepage. The artefact thus produced is characterized by a small, circular black or gray spot which frequently falls on the cardiovascular silhouette. It can be eradicated by taping the camera in this area with ordinary electrician's black tape. **(b).** One form of light leakage particularly presented a baffling problem for some time. This was due to the inconstancy of the findings, that is, films would be light struck only on certain days and not all of the films on any one day would be so involved. It was finally discovered that a leak in the door of the camera existed which permitted light in significant quantity to enter only when the sun shone directly on the camera. Of course, this type of light leak results in a uniform graying or blackening of the film. It can be ruled out by placing a small flashlight in the camera in the dark room and noting whether or not light diffuses out. If so, a piece of black tape can be placed over the top of the camera door. Better still, the camera should be replaced because it will probably leak in other places also.—Shapiro, Robert, Lt. j. g. (MC) USNR. Naval Construction Training Center, N. O. B., Norfolk, Va.

A COMPARATIVE STUDY OF CHEST X-RAY SURVEY METHODS¹

ARTHUR B. ROBINS

Lieutenant (MC) U. S. N. R.

Considerable interest has been shown in recent years in the problem of rapid chest x-ray examination of large groups of people. This subject has received increased attention as a result of the adoption of chest x-ray as a fundamental part of the physical examination for active service in both Army and Navy. Four methods of rapid mass radiological examination are in common use. These are fluoroscopy, the roll paper process, and photofluorography on either 4- by 5-inch or 35-mm. film. A number of studies and discussions of these methods have appeared in the literature recently. These include the papers of Fellows and Ordway (1), Potter (2), Douglas and Birkelo (3), Bridge (4), Hirsch (5), Plunkett, Weber, and Katz (6), and the reports of the Committee on X-ray Apparatus and Technique of the American Trudeau Society (7) and of Pendergrass, Warren, and Haagensen (8). Unfortunately no consensus is present in these communications as to the most suitable survey method or even as to the method with the highest degree of diagnostic accuracy.

In view of the diversity of opinion, it seemed advisable to conduct a comparative study of mass chest x-ray survey methods as they applied to our particular problem, the examination of large numbers of civil employees in a navy yard. Any method to be used in an undertaking of this nature must be rapid, convenient, and relatively inexpensive. The examinations have to be carried on during the employees' working hours on Government time, and speed in making the exposures is essential. The time of the reviewer reading the films must also be reduced to a minimum. General experience indicates that all of the methods except fluoroscopy satisfy these two criteria. Because of these deficiencies and the failure to provide a permanent record, fluoroscopy was eliminated from further consideration. The nature of the conditions under which the yard operates made it advisable to plan for x-ray service on a contract basis rather than by procuring and maintaining our own equipment and personnel. It was, therefore,

¹ Received for publication January 30, 1943.

impossible to consider the 4- by 5-inch photofluorographic method, as no commercial contract service using this type of machine is available. Thus the choice fell between rapid roll paper and 35-mm. fluorography.

In planning the comparative study the basic requirements of our particular set-up had to be borne in mind. One was the necessity for the highest degree of accuracy in detecting pathological pulmonary changes. The civil employees to be x-rayed are all Federal employees and as such are entitled to sick leave, vacation time, and compensation. From the legal point of view the interests of the Government can only be fully protected if tuberculosis, pneumoconiosis, and other pathological pulmonary conditions are clearly recognized on the initial survey film. On the other hand, any tendency toward overreading of the roentgenograms of normal persons results in an increase in the number of x-rays to be retaken, and consequently to loss of valuable production time.

With these considerations in view, representatives of the companies offering 35-mm. photofluorographic and roll paper x-ray service were invited to participate in a comparison test, which they readily agreed to do. A location was selected, and the companies set up their apparatus as for a large-scale survey. A power line used exclusively by the x-ray department, which was free from significant line voltage fluctuations, was provided. A series of 60 selected cases was then x-rayed, first by the roll paper method and then by 35-mm. photofluorography. The series included individuals with minimal and moderately advanced tuberculosis, calcified primary tuberculous foci, pneumoconiosis, and a number of normal controls. Full-size celluloid films were available on all of the cases. The exposures were made by technicians employed by the participating companies, and the processing of the film done in the companies' plants. No limitations were placed on the speed with which the x-rays were to be taken or developed during the test. The companies provided their own viewing devices for reading films.

Four roentgenologists attached to the x-ray departments of three naval establishments in the city were asked to appraise the films. All were experienced in interpreting chest x-rays, and two of them had seen a large number of 35-mm. photofluorograms previously. The author did not participate in the test, as he had selected the cases and was familiar with them. The procedure employed in reading the films was as follows:

All 60 films on one test medium were read and recorded, and then all 60 films on the other test medium were read and recorded.

Two roentgenologists reviewed the paper films first, the other two the 35-mm. films first.

The 60 14- by 17-inch celluloid films were reviewed and described after the readings of the 35-mm. and paper films had been done.

No comparison of the different types of films taken on the same patient were made until the interpretations of all three sets of films had been completed.

All abnormalities, irrespective of their clinical significance, were noted on the records.

The findings of the four roentgenologists were then analyzed to determine the frequency with which lesions were missed or incorrectly described as being present on the 35-mm. or paper films. Each physician's own interpretations of the 14- by 17-inch celluloid films were accepted as correct, and used as a basis for comparison with his readings on the other two media. Only parenchymal lesions such as reinfection tuberculosis, calcified primary tuberculosis, or pneumoconiosis were considered in the scoring. A lesion was considered missed if it was described on the full-size celluloid film but not identified on either or both of the survey films. A lesion was also considered missed if it was noted in only one lung field on a test film and on both sides on the 14- by 17-inch celluloid film. A survey film was regarded as having been overread when the presence of any of the above type of lesions was described and not confirmed on the corresponding conventional film.

The results of the study are shown in tables 1 and 2.

TABLE 1.—Numbers and percentage of missed lesions on 35-mm. and paper chest x-ray films.

Roentgenologist	Lesion missed on 35-mm. film only		Lesion missed on paper film only		Lesion missed on 35-mm. and paper film		Total number of cases with lesions	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
A.....	2	9.5	1	4.8			21	100.0
B.....	5	22.7					22	100.0
C.....	8	36.4			2	9.1	22	100.0
D.....	3	14.3			1	4.7	21	100.0
All.....	18	20.9	1	1.2	3	3.5	86	100.0

TABLE 2.—Number and percentage of lesions overread on 35-mm. and paper chest x-ray films.

Roentgenologist	Lesion described on 35-mm. film only		Lesion described on paper film only		Lesion described on 35-mm. and paper film		Total number of cases reviewed	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
A.....	9	15.0	3	5.0	1	1.7	60	100.0
B.....	2	3.3	2	3.3			60	100.0
C.....			1	1.7			60	100.0
D.....	6	10.0	2	3.3			60	100.0
All.....	17	7.1	8	3.3	1	0.4	240	100.0

It is apparent that under the conditions of our study, paper film was a more accurate diagnostic medium than 35-mm. photofluorography. Parenchymal lesions noted on the 14- by 17-inch celluloid films were missed in only 1 instance on the paper films, whereas they were not identified 18 times on the small films. The majority of these, of course, were not conditions of clinical significance. The disparity between the media in regard to overreading was not as great. On 7.7 percent of the photofluorograms and 3.3 percent of the paper films, lesions were described which were not confirmed on the corresponding celluloid films. All of these cases would have required retakes on 14- by 17-inch celluloid films under survey conditions. It should be emphasized that the percentage of missed lesions was calculated on the basis of the total number of instances in which lesions were observed rather than on the basis of the total number of cases x-rayed. The percentage of films overread, however, was computed on the basis of the total number of individuals examined. This seems to us the only sound method of estimating percentages of missed lesions and overreading, as it is not possible to miss a lesion when none is present, whereas a lesion can always be read into any film.

The findings in this test agree in general with reported studies on mass chest x-ray survey methods. The latter have dealt almost entirely with the accuracy of the methods in regard to infrequency of missed lesions, and paper film has usually been ranked next to 14- by 17-inch celluloid film. None of these reports deals with the question of overreading on the various media, although under some conditions this may be almost as important a problem as underreading. In a large-scale survey in which 50,000 to 75,000 individuals are to be examined, overreading of films in only 4 percent of the cases will necessitate re-x-raying 2,000 to 3,000 persons unnecessarily. The resultant loss of production time in a place like a navy yard may far outweigh the cost of the additional films.

SUMMARY

In conclusion it may be stated that in a comparative test of paper film taken by the rapid roll paper method and 35-mm. photofluorograms, carried on under the circumstances described, paper film proved the more satisfactory medium in diagnostic accuracy. Fewer lesions were missed, and there was less tendency to report lesions which could not be confirmed on 14- by 17-inch celluloid films. These factors should be taken into consideration in the choice of a survey method. Comparison of the relative costs of the various methods cannot be based on the price of the initial films alone. Allowance must be made for differences in the expected number of retakes, not only in terms of the cost of the additional films but also in regard to the value of the lost

production time. Calculated on this basis, the least expensive method providing satisfactory films is the medium of choice for any survey.

Acknowledgment.—The author wishes to acknowledge the cooperation of Drs. J. J. Sher, E. J. Ryan, J. Gershon-Cohen, and A. D. Young, all U. S. Naval Reserve, in the reading of the x-ray films.

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CITRATE THERAPY IN LEAD POISONING

Nine of the fifteen patients for an interval after admission received no medication likely to influence lead metabolism. Pain was controlled by tincture of belladonna, codeine, or morphine, constipation treated with cascara sagrada, and no other drugs were administered. In this manner control periods were obtained and used as a means of better evaluating the citrate treatment. During the period of citrate therapy the patients were given 4 or 5 gm. of sodium citrate dissolved in 1 ounce of water, 3 or 4 times daily. Four patients presenting severe colic on admission were given at once 50 cc. of a sterile 2.5 percent aqueous solution of sodium citrate by vein. No other drugs, with the single exception of cascara, were administered or even found necessary during the citrate treatment. All patients received the regular hospital diet throughout the study.

The results of citrate therapy on 15 cases of lead poisoning in adults are presented.

There is a marked and significant fall in blood lead concentration during citrate administration.

There is an immediate and persistent amelioration of symptoms of lead poisoning during and after citrate therapy.

Intravenous administration of sodium citrate relieved severe colic immediately in 2 of 4 patients presenting this symptom.

No reactions or ill-effects of sodium citrate, or recrudescence of symptoms of lead poisoning were observed at any time.—Kety, S. S., and Letonoff, T. V.: The treatment of lead poisoning by sodium citrate. *Am. J. Med. Sc.* 205: 406-414, Mar. 1943.

ORTHOPEDIC CONDITIONS REQUIRING MEDICAL SURVEY AMONG MARINE RECRUITS ¹

PAUL E. McMASTER

Lieutenant Commander (MC) U. S. N. R.

A large number of orthopedic conditions of a disabling nature, some being apparent and others more obscure, are overlooked in the recruiting of men into the Marine Corps. A brief review of 437 such cases in a 6-month period requiring medical survey at the Marine Corps Base, San Diego, Calif., is herein presented. The period covered was from July 1 to December 31, 1942, inclusive. Each condition in this group existed prior to enlistment. No cases are included which required survey after the men finished their recruit training.

Excluding the neuropsychiatric survey cases there was a total of 612 cases surveyed which included dental, medical, surgical, and orthopedic conditions. Thus the orthopedic cases represented over 70 per cent of all the surveys exclusive of the neuropsychiatric. The latter number for the same period was 1,478, being by far the most common cause for survey.

All of the orthopedic cases with few exceptions were seen by the writer and every reasonable effort was made to "salvage" each individual. However, when it was apparent that either the condition was not or could not be helped by treatment or the man refused treatment, as in some surgical conditions, he was surveyed.

The following table lists the causes of survey and the number of each:

Cause of survey	Number of cases	Cause of survey	Number of cases
Amputations, traumatic, right index finger.....	1	Chilblain (pernio).....	1
Arthritis, chronic.....	21	Cicatrix, skin.....	6
Metatarso-phalangeal.....	2	Foot.....	4
Tarsus.....	2	Knee.....	1
Ankle.....	5	Calf.....	1
Knee.....	4	Coxa vara (Osteochondritis deformans).....	6
Hip.....	3	Curvature, spine.....	17
Sacroiliac.....	2	Cyst, knee (Baker's).....	1
Spine.....	2	Cyst, teratoma, pilonidal.....	3
Acromioclavicular.....	1	Defective physical development.....	1
Bursitis, chronic.....	2	Deformity, acquired.....	11
Shoulder.....	1	Foot.....	5
Infrapatellar.....	1	Shoulder.....	2
		Skull.....	1

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Cause of survey	Number of cases	Cause of survey	Number of cases
Deformity, acquired—Continued.		Osteomyelitis, chronic.....	6
Wrist.....	2	Tibia.....	2
Finger.....	1	Femur.....	2
Deformity, congenital.....	9	Spine.....	1
Foot and toes.....	3	Humerus.....	1
Sacralization lumbar spine.....	3	Paralysis, ulnar nerve (posttraumatic).....	2
Lumbarization sacral spine.....	1	Pes cavus.....	6
Spondylolisthesis.....	1	Poliomyelitis, anterior chronic, with paralysis.....	11
Spina bifida occulta.....	1	Leg muscles.....	10
Dislocation, articular cartilage, knee.....	62	Shoulder muscles.....	1
Dislocation, chronic, recurrent.....	23	Sprain, chronic, ankle.....	2
Shoulder.....	20	Synovitis, chronic.....	4
Acromioclavicular.....	1	Knee.....	3
Patella.....	1	Ankle.....	1
Head of radius.....	1	Talipes (clubfoot).....	4
Dislocation, chronic, peroneus longus tendon at ankle.....	1	Thrombosis, femoral vein.....	1
Flat foot.....	103	Union of fracture, faulty.....	63
Fracture, simple, tibia.....	1	Radius.....	3
Genu recurvatum.....	1	Ulna.....	8
Genu valgum.....	2	Radius and ulna.....	5
Hallux valgus.....	1	Carpal scaphoid.....	3
Hammertoe.....	2	Humerus.....	7
Hemangioma, hand.....	1	Clavicle.....	1
Hernia, leg muscle.....	1	Mandible.....	1
Hypopituitarism.....	1	Vertebra.....	5
Joint, internal derangement of, knee.....	8	Femur.....	3
Loose body in joint, knee.....	9	Tibia.....	18
Metatarsalgia.....	4	Patella.....	5
Myositis, chronic.....	12	Astragalus.....	1
Myositis, traumatic ossifying.....	1	Metacarpal.....	1
Osgood-Schlatter disease.....	10	Metatarsal.....	1
Osteitis fibrosa cystica.....	2	Odontoid.....	1
Osteochondritis, dissecans.....	1	Varicose veins.....	3
Osteochondroma.....	7	Wounds, gunshot.....	2
Single.....	5	Buttocks.....	1
Multiple.....	2	Foot.....	1
Osteochondromatosis, knee.....	1		

COMMENT

Flat feet which usually were of an advanced degree of flatness, pronation and eversion, accounted for nearly one-fourth of the surveys. Attempts were made to salvage a number of these cases by the various conservative methods of treatment. Some responded but most had to be surveyed later.

Lesions of the knee were next in frequency after the foot and were responsible for nearly one-fourth of the total cases. The most common knee condition (62 cases) was dislocation of the articular cartilage (semilunar). There were eight cases of internal derangement, including torn ligaments, and two cases of cyst of external semilunar cartilage. Football injuries accounted directly for over 90 percent of the above knee conditions. A large number of other "football knees" were treated conservatively and kept at duty, although frequent periods of 1 to many days in sickbay were not uncommon in these cases. Several of the latter are known to have been surveyed elsewhere after finishing recruit training. Surgical removal of the injured cartilage, which was done in a few cases, was not always successful, as indicated by subsequent pain, swelling, and weakness, especially with any stren-

uous exertion. These postoperative symptoms seemed to occur particularly in those cases with a long standing history of knee trouble and in those who were returned too early, before 8 weeks, to active marine duty.

Gross deformities apparent and palpable, as well as limited or absent joint motions were common findings in the faulty united fractures. One man was accepted for service who had had a recent fracture of the tibia and was still wearing a plaster cast.

A number of these cases could have been kept in the Marine Corps if there had been some provision for "limited duty." The latter opportunity however, only applied to a small special group of older enlisted men.

SUMMARY

Four hundred and thirty-seven surveys of orthopedic conditions at the Marine Corps Base, San Diego, Calif., in a 6-months' period are briefly reviewed and summarized.

Excluding the neuropsychiatric surveys the orthopedic conditions represented over 70 percent of all other medical surveys including dental.

The three most common diagnoses in the order of their frequency were: Flat feet, injuries of the knee, and faulty union of fracture.

Many of the cases wanted to remain in the Marine Corps and could have been kept if there had been a provision for "limited duty."



PULMONARY NODULAR INFILTRATIONS IN INFLUENZA RESEMBLING AN EARLY TUBERCULOSIS

When there is an increase in the incidence of sporadic cases of influenza, then there is an increase also in the group characterized by a nodular infiltration of the lungs that must be differentiated from an early tuberculosis infiltration. This fact has been known for many years, but recently the detection of the nodular type has been made easier by roentgen-ray examination. With more frequent roentgenography of the lungs, as a routine procedure, clinicians have been impressed with the fact that after a short period of fever, etc., lung pathology is often discovered in influenza cases which had no correlative, significant, disabling symptoms except persistent cough and mucopurulent sputum. If a patient is critically ill, the clinician is practically forced to rule out a "probable" pulmonary tuberculosis.

Early in influenzal attack or later during the stage of organization or delayed resolution when clinical symptoms are insignificant or absent, a roentgenogram taken then will often show shadows suggestive of a nodular tuberculous condition. These shadows, or abnormal variations in the density of the lung parenchyma and air passages, usually represent a slowly organizing pneumonic process when they are examined under the microscope.—Schlomovitz, B. H.: Pulmonary nodular infiltration in influenza resembling an early tuberculosis. Wisconsin M. J. 42: 296-298, Mar. 1943.

PREDISPOSITION TO COMPRESSED AIR ILLNESS¹

IRVING J. THORNE
Lieutenant (MC) U. S. N. R.

The type and extent of aerial warfare in the present great world conflict, of necessity demands a large number of competent pilots and aviation personnel. The successful operation of our greatly increasing air armada depends on a thoroughly trained force. Because of the excessive physical and mental strain which aerial combat produces, it is necessary to select young men who can successfully cope with the emergencies of aerial combat.

With this thought in mind, this article is presented. It is hoped that the information gathered from the experiences of the author with the "bends" of compressed-air workers, may be of assistance in the selection and classification of aviation personnel for high-altitude flying.

The three foremost problems facing the high-altitude flier are:

1. Anoxia from decrease in concentration of oxygen.
2. Inequality of pressures in the body cavities and orifices.
3. Aviator's "bends" (aero-embolism; nitro-embolism).

Although most individuals show varying degrees of resistance and susceptibility to decrease in oxygen concentration, this problem is largely offset by the availability of 100 percent oxygen for inhalation purposes in high-altitude flight.

The ability of an individual to equalize pressure in the body cavities and orifices will be easily ascertained by a test in a steel chamber from which the air is exhausted. This test simulates high-altitude flight by decreasing the air pressure. Individuals who suffer with chronic upper respiratory infections will have difficulty in equalizing pressure in the middle ear and sinuses. Inability to equalize pressure is denoted by pain in the sinuses or ears. These symptoms are indicative of mechanical block in the ostia of the sinuses or eustachian tubes. This condition may be temporary or permanent. If it results from mild infection of the upper respiratory passages, the symptoms will disappear with clearing of the infection. If it is caused by definite obstructions such as hypertrophied lymphoid tissue or deviated septum, the individual will suffer from repeated attacks of ear or sinus block upon exposure to change in pressure in the exhaust chamber and he will therefore be designated as unfit (1) (2).

¹ Received for publication December 18, 1942.

Aviator's bends (aero-embolism; nitro-embolism) remains therefore as the most dangerous enemy of the high-altitude aviator, assuming there is adequate supply of oxygen to prevent anoxia. It is with this disability that the following study is chiefly concerned.

Most modern investigators in this field concede the similarity of bends of compressed air origin and that of high-altitude flight. They also agree as to the common causative factor producing the disease, e. g., nitrogen-bubble formation. Recompression relieves compressed air illness, and descent from high altitudes (which is essentially recompression) relieves aero-embolism.

High-altitude flying is in reality a decompression process similar to the decompression of compressed-air workers and deep-sea divers. It differs only in the amount of air pressure to which one is exposed. In the latter case we are concerned with decompression from several atmospheres to normal atmospheric pressure. In the former instance, decompression is from normal atmospheric pressure to pressures approaching zero, depending on the altitude attained. Conclusive proof of the cause of compressed-air illness and the cause of aero-embolism has recently been demonstrated by Armstrong (3). He refers to the presence of nitrogen emboli in the tissues and blood of high-altitude fliers.

Since the mechanism of the causation of aero-embolism involves the laws of gases in simple solution and under pressure, a study of these laws and principles as described in various textbooks of physics will lead to a better understanding of the processes in this condition (4). The only route by which nitrogen can be absorbed and excreted is via the lungs during respiration, the blood acting as a vehicle of transportation to and from the tissues and organs of the body. Pathological conditions of respiration and circulation decrease the rapidity of the nitrogen elimination from the tissues.

It has been my observation that aero-embolism occurred even under ideal conditions of prevention and decompression. If the theories regarding its causes are correct, theoretically there should be no bends. However, this has not been my observation or experience. The occurrence of these unexplained attacks presented a challenge to medicine. As a result, studies were undertaken in an effort to find adequate explanations.

FACTORS PREDISPOSING TO AERO-EMBOLISM

Table 1 is a study of the incidence of aero-embolism according to age groups. The results indicate that with increase in age there is an increase in the incidence. However, all the physical characteristics of the individual must be taken into consideration. For example, a

worker may be 45 years of age but still be as physically fit as a man 10 years his junior, insofar as his cardiovascular system is concerned. However, increase in age is usually a disqualifying factor because it is usually accompanied by degenerative circulatory conditions such as arteriosclerosis, hypertension, and other diseases affecting the cardiovascular system.

TABLE 1.—*The influence of age.*

Age group	Number of men	Number of cases	Percent-age	Age group	Number of men	Number of cases	Percent-age
20 to 24 years.....	300	40	13.3	45 to 49 years.....	241	79	32.7
25 to 29 years.....	275	52	18.9	50 to 55 years.....	236	78	33.5
30 to 34 years.....	257	63	24.5				
35 to 39 years.....	249	71	28.6	Total.....	1,788	456	-----
40 to 44 years.....	230	73	31.7				

The 456 cases in table 1 were analyzed from the point of view of weight and obesity. The results are presented in table 2. The figures prove that the heavy, obese individual is more susceptible than is the lean (5). This is observed in all age groups studied. As one grows older, there is a tendency to the deposition of fat throughout the body, particularly the abdomen. It must be pointed out here, however, that an individual may be heavy and still not be obese. Large bones and well-developed muscles may contribute to most of an individual's avoirdupois. Careful physical examination, height, weight, chest, and abdominal measurements will generally indicate into what group the individual will fall.

TABLE 2.—*The influence of weight and obesity*

Age	Number of cases	Cases lean	Percent	Cases medium	Percent	Cases heavy	Percent
20 to 24 years.....	40	4	10	13	32.5	23	57.5
25 to 29 years.....	52	5	9.7	16	30.7	31	59.6
30 to 34 years.....	63	7	11.2	19	30.1	37	58.7
35 to 39 years.....	71	6	8.5	24	33.8	41	57.7
40 to 44 years.....	73	5	6.9	25	34.2	43	58.9
45 to 49 years.....	79	4	5.1	21	26.6	54	68.3
50 to 55 years.....	78	2	2.6	19	24.3	57	73.1

According to my observations, repeated exposures to compressed air did not necessarily predispose an individual to aero-embolism. These observations were revealed on examination and study of the records and histories of 1,788 men as reported in table 1. It was also observed that individuals who at one time or other have suffered from aero-embolism did not of necessity have repeated occurrences of this malady upon successive exposures to compressed air.

TABLE 3.—*The influence of repeated exposures to compressed air*

Years of experience	Number of men	Total number of cases of bends reported	Average number of attacks per man
0 to 9 years.....	832	1,269	1.52
10 to 19 years.....	621	1,521	2.43
20 to 30 years.....	335	1,179	3.52

Table 3 reveals the number of cases of bends in compressed-air personnel for 1 year. The compressed-air personnel was divided into groups according to their years of experience in compressed air. Workers averaging 1 to 10 years of experience in compressed air averaged 1 to 2 cases. Men with 20 years of experience averaged 2 to 3 attacks, while those with 30 years averaged 3 to 4 a year.

In the series of 456 cases reported in table 1 there were 62 men (7.4 percent) who suffered from repeated attacks. All were men in the older age groups (40 to 50 years), or were in the heavy, obese classification. It was necessary to reject these men for further work in compressed air.

Practically every compressed-air worker has at some time during his career suffered an attack of bends. Some reported 2 attacks while others with 20 to 30 years of experience have had as high as 30 attacks during their careers. If compressed-air personnel were disqualified on the basis of an isolated attack there would be a very negligible number of men available for work in this field. The same would be true of the personnel of deep-sea diving and high-altitude flying. When the multiplicity of conditions that may temporarily predispose an individual to aero-embolism is realized, adequate explanations may be afforded.

THE INFLUENCE OF TEMPERATURE CHANGES

Upon the introduction of decompression chambers for the decompression of compressed-air workers, it was observed that lowering of the temperature in the chamber, as occurs during decompression, resulted in a decided increase in the bends. During the actual decompression process there is a steady drop in temperature. The rapidity of the temperature fall depends largely on the rapidity of decompression, which is accompanied by a decided cooling effect on the body. This cooling causes vasoconstriction of the superficial blood vessels, with delayed reabsorption of the nitrogen from the tissues. The introduction of adequate heating apparatus into the decompression chamber to maintain a uniform temperature during the decompression process, caused a decided decrease in the occurrence of compressed-air illness (6).

During the compressed-air operations at the Norfolk Navy Yard, during the construction of the drydocks in 1942, the author observed a decrease of 70 percent in the incidence of aero-embolism after facilities were instituted to prevent abnormal chilling of compressed-air personnel, upon their emergence from the decompression chamber. The influence of sudden decrease in temperature on the incidence of the bends should be of particular significance in high-altitude flying, since at altitudes of 40,000 feet the temperature is -50° C. Unless the personnel in a plane at this altitude is adequately protected by suitable warm clothing or heating devices that are efficient, the chances of developing aero-embolism will be greatly increased.

From the above observations it can be seen that simulating the low temperatures of high-altitude flight in the low-pressure chamber, will result in a decided increase in the incidence of aero-embolism.

TABLE 4.—*Factors contributing to aero-embolism*

Factor	Number	Percent of total	Factor	Number	Percent of total
Fatigue.....	67	17.1	Gastro-intestinal complaints.....	38	9.6
Neurogenic.....	58	15.7	Constipation.....	49	12.4
Alcohol.....	49	12.4	Faulty diet.....	21	5.5
Nicotine.....	53	13.8	Total.....	403	100.0
Acute upper respiratory infection.....	68	17.3			

THE INFLUENCE OF MISCELLANEOUS FACTORS

In the examination of the histories of the unexplained cases of bends, I observed certain miscellaneous factors common to many of them (table 4). The action of these factors can be explained by their depression of the physiological processes of the body as a whole. The cardiovascular system, on which the excretion of nitrogen gas from the tissues and organs depends, shares in this secondary depressing effect, thus predisposing the body to nitrogen-bubble formation by the reduction of the rate of nitrogen desaturation from the tissues.

Fatigue can result from a variety of causes. Encountered in this analysis are cases of fatigue resulting from strenuous physical exertion and lack of sleep. The depressing effect caused by fatigue on the circulation will result in decreased ability of the blood to rid the body of excess nitrogen. The duties of a compressed-air worker are arduous. The environment in which he carries on his occupation is warm, damp, and poorly ventilated. A tremendous amount of physical exertion is necessary in a short space of time. Perspiration is profuse with much loss of fluids and electrolytes, mostly sodium chloride. This loss of fluid and sodium chloride is in itself very debilitating and unless adequate rest is obtained and the fluids and chlorides are replenished, there will result a marked predisposition to aero-embolism.

The importance of neurogenic factors and their effect on the normal physiological processes of the body cannot be too strongly emphasized. The exhausting effect of such conditions as worry, fear, anxiety, depression, etc., on the body economy of the individual is well recognized. A pressing domestic or financial problem may so play upon the mind of an individual as to reduce materially his circulatory efficiency.

The influences of alcohol and nicotine are largely the results of their effect on the cardiovascular system. Diehl observed that the mean grade on the Schneider cardiovascular physical fitness test was significantly lowered in smokers as compared to nonsmokers (9). McDowall (10) noted that alcohol in large quantities acts as a cardiac depressant and thereby reduces the efficiency of the circulation. The above effects cause a decrease in the nitrogen desaturation of the tissues predisposing to aero-embolism.

Other miscellaneous conditions are acute upper respiratory infections, gastro-intestinal complaints, constipation, and faulty diet. Diets rich in fats and those productive of much gas should be avoided. The fat in the diet will act as a reservoir for nitrogen. Gas-producing foods should be minimized to prevent the production of too large an amount of nitrogen gas in the gastro-intestinal tract.

PROPHYLAXIS

If the nitrogen dissolved in the body tissues and organs could be dissipated, there would be no nitrogen available to produce the bends. Although this would be the ideal state of affairs, unfortunately it does not work out as perfectly from a practical standpoint. Much can be done, however, to displace nitrogen from the tissues and blood to an extent that will greatly reduce the hazard. The following prophylactic measures can be instituted to increase the resistance to aero-embolism.

PRE-OXYGENATION

Oxygen inhalation was used in 1897 by Zuntz for hastening the elimination of nitrogen from the body during decompression. Von Schrötter and Boinet in 1907 used 100-percent oxygen for similar purposes. Behnke studied the effects of oxygen in preventing the bends in divers and obtained good results. Inhalation of 100-percent oxygen under pressures greater than 1 atmosphere results in undesirable toxic effects (11). The toxic effects, however, are absent under pressures of less than 1 atmosphere. I have observed that inhalation of oxygen during the last 30 minutes of decompression reduced the incidence of bends 73 percent. This method of eliminating nitrogen from the body tissues would be of great advantage in aviation personnel prior to high-altitude flight.

THE USE OF OXYGEN AND HELIUM MIXTURES

The recent production of large amounts of helium gas has encouraged its more extensive use. Its use in deep-sea diving has allowed divers to attain depths heretofore considered impossible (13). Behnke has shown that helium gas is only one-third as soluble in fat as compared to nitrogen. He also observed that oxygen (20 percent) and helium (80 percent) mixture when breathed is as effective in removing body nitrogen as pure oxygen. Therefore, the quantity of gas available for bubble formation would be much less and the tendency to aero-embolism would be greatly reduced. However, it then becomes necessary to rid the body of helium gas to obviate the occurrence of helium aero-embolism. This can be accomplished by the inhalation of 100-percent oxygen. It takes 90 minutes of oxygen inhalation to rid the body of most of the helium gas. If the body were in nitrogen equilibrium, it would necessitate a 5-hour period of oxygen inhalation to rid the body of most of its nitrogen. The use of helium therefore, reduces the pre-oxygenation period from 5 hours to 1½ hours. Behnke (14) suggests the conditioning of pilots preparatory to high-altitude flight by the use of special rooms in which aviation personnel can carry on their normal routine while breathing the oxygen-helium mixture. It appears that such "ready" rooms as described above for conditioning aviation personnel preparatory to high-altitude flight should prove of immense practical value.

THE USE OF EXERCISE

The importance of exercise in stimulating the exodus of nitrogen from the body tissues was realized as far back as 1907. The beneficial effect of exercise is derived from its stimulation of the circulation and the respiration. There is an increase in circulatory rate, an increase in cardiac output and an increase in venous return to the heart. The accelerated physiological processes favor the desaturation of the tissues and blood of excess nitrogen, thus decreasing the possibility of the formation of nitrogen bubbles. The total blood volume in an average normal man at rest circulates approximately once a minute. The volume of blood in a normal average man is approximately 3.5 liters. During physical exertion, the demand of the tissues and organs of the body for oxygen is increased. This demand for oxygen is met by the circulation by increasing its circulatory rate three, six, or ten times normal, depending on the degree of exertion. Since nitrogen desaturation takes place through the lungs, with the blood acting as the vehicle of transportation, exercise will enhance the desaturation of the tissues of nitrogen. It is possible that the pre-oxygenation period for nitrogen elimination preparatory to high-altitude flight may be reduced to a figure below 90 minutes by the introduction of

exercise. Gymnastic apparatus, mechanical bicycles, rowing machines and other devices might be included in the equipment of the conditioned "ready" room to be used at the pilot's leisure during the period of conditioning preparatory to high-altitude flight.

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A study of the Public Health Reports (57: 2000-2002, 1942) reveals that for the first 9 months of 1942 there were 837 cases of plague in India; 22,380 cases of smallpox in India; 34,913 cases of typhus fever in Algeria, 22,653 in Egypt, 25,666 in Morocco, and 16,152 in Tunisia.—Editorials: The annual session. *J. Missouri M. A.* 40: 115, April 1943.

A CLINICAL STUDY OF THE RESULTS OF EXPOSURE OF LABORATORY PERSONNEL TO RADAR AND HIGH FREQUENCY RADIO ¹

L. EUGENE DAILY

Lieutenant Commander (MC) U. S. N.

Because of the rapid development and use of radar and high-frequency radio in recent months, and the inquiries that have been made to the Naval Research Laboratory and the Bureau of Medicine and Surgery, it is thought advisable to present the clinical findings that are available at this time.

For the past 12 months we have been able to observe personally the civilian personnel connected with the experimental radar work at the Naval Research Laboratory. These individuals have been working continuously, day after day, and sometimes day and night, with the equipment, and their period of association with it varies from 2 months to 9 years. (See table 1.)

TABLE 1.—*Periods of exposure of laboratory personnel*

Case No.	Months on duty at Naval Research Laboratory	Months exposed to radar	Average exposure during 8-hour shift (hours)	Case No.	Months on duty at Naval Research Laboratory	Months exposed to radar	Average exposure during 8-hour shift (hours)
1.....	12	12	3-4	24.....	18	18	5-6
2.....	14	14	3-4	25.....	14	14	3
3.....	9	3	3-4	26.....	32	32	3
4.....	14	14	1-2	27.....	17	17	4
5.....	52	52	4	28.....	12	12	6
6.....	18	18	2-3	29.....	12	12	2-7
7.....	24	24	3-4	30.....	15	15	1
8.....	54	48	4	31.....	9	9	0-1
9.....	12	12	3-4	32.....	12	12	3-4
10.....	12	12	8	33.....	9	6	1-2
11.....	24	24	8	34.....	18	18	1-2
12.....	42	42	1-2	35.....	12	12	1-2
13.....	19	19	3-4	36.....	30	30	4-5
14.....	6	6	4-5	37.....	29	29	5
15.....	2	2	0-1	38.....	12	12	2
16.....	10	10	6	39.....	9	9	3
17.....	10	10	3	40.....	12	33	6
18.....	24	24	4	41.....	5	5	4-5
19.....	5	3	3	42.....	30	30	5
20.....	33	33	8	43.....	14	14	6
21.....	13	13	2-8	44.....	12	12	4
22.....	20	20	8	45.....	192	108	7
23.....	18	18	3-4				

Approximately 8 months ago the Naval Research Laboratory was requested to furnish data to the Bureau of Ships as to whether or not this equipment gave off any harmful radiations, and if so, what they

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were. A report on this subject was written by Mr. J. B. Trevor, radio engineer; we assisted him in his tests. His report was essentially a technical one. Suffice it to say that the harmful radiations, if any, that are given off by this apparatus would be soft gamma or Grenz rays. On the strength of that report and one from the Research Division of the Bureau of Medicine and Surgery, various recommendations were made by the Bureau of Medicine and Surgery to the Bureau of Ships and a directive was issued by the Surgeon General. Mr. Trevor's report was recently confirmed by a National Defense Research Committee report on the same subject.

TABLE 2.—*Blood pictures of exposed personnel*

Case No.	Red blood count	Hemoglobin (percent)	White blood count	Differential					
				Band	Seg.	Lymph.	Mono.	Eosino.	Baso.
1	5,030,000	96	10,000	2	71	27	0	0	0
2	4,870,000	100	13,200	0	65	28	5	2	0
3	4,690,000	107	5,500	1	58	29	5	6	1
4	4,540,000	100	10,800	0	64	29	6	1	0
5	3,990,000	88	5,600	0	49	48	2	1	0
6	4,320,000	95	9,200	1	57	38	2	1	1
7	4,200,000	100	7,400	1	71	23	3	2	0
8	4,870,000	107	9,900	1	70	25	4	0	0
9	4,380,000	96	7,100	0	65	23	5	3	4
10	4,110,000	90	10,200	2	75	20	2	1	0
11	4,980,000	100	9,000	1	57	40	1	0	1
12	4,710,000	93	12,200	1	63	33	2	1	0
13	4,280,000	92	4,500	2	58	19	11	7	3
14	4,210,000	100	7,800	0	53	39	6	2	0
15	4,200,000	100	4,300	0	69	27	1	3	0
16	5,110,000	100	7,200	1	63	34	2	0	0
17	4,820,000	100	9,000	1	66	29	1	3	0
18	4,320,000	95	7,800	0	43	42	7	5	3
19	4,210,000	100	8,400	0	74	24	2	0	0
20	3,710,000	90	9,300	0	62	37	0	1	0
21	4,630,000	96	8,100	0	54	42	3	0	1
22	4,230,000	100	6,900	0	58	41	1	0	0
23	4,880,000	107	7,900	1	73	22	1	3	0
24	4,660,000	96	9,200	1	67	28	1	3	0
25	4,920,000	100	5,900	1	69	29	1	0	0
26	4,620,000	96	6,800	0	51	44	4	1	0
27	4,470,000	95	8,400	1	66	27	4	2	0
28	4,450,000	100	7,900	0	56	30	7	7	0
29	4,480,000	93	10,700	1	61	32	4	2	0
30	4,730,000	96	5,200	0	74	25	1	0	0
31	4,320,000	93	3,600	0	38	52	8	2	0
32	4,550,000	100	7,400	2	44	43	6	3	2
33	4,440,000	100	6,200	1	55	42	1	1	0
34	4,220,000	96	6,000	1	65	31	2	1	0
35	4,440,000	100	7,400	0	67	27	5	1	0
36	5,050,000	95	6,000	1	51	43	1	3	1
37	4,230,000	95	9,700	1	52	42	4	1	0
38	4,900,000	95	4,900	2	65	29	2	2	0
39	4,460,000	92	5,700	0	59	34	2	5	0
40	5,220,000	100	7,100	2	35	34	3	*26	0
41	4,130,000	103	8,000	0	59	34	7	0	0
42	4,780,000	107	6,700	1	67	29	2	1	0
43	4,310,000	95	7,300	0	58	38	2	2	0
44	5,360,000	105	8,000	1	65	30	4	0	0
45	4,950,000	92	9,700	1	73	17	8	1	0

It is to be noted that there are 6 cases in which the WBC is 10,000 or over. These cases were suffering from upper respiratory infections at the time the count was taken. This percentage of respiratory infections is much less than the average found at this time of the year in the Washington area.

It is also to be noted that there are 2 cases of mild secondary anemia. These are not thought to be significant in a group of 45 persons whose work is almost completely indoors, with practically no exercise and with many more hours of work per day than the average individual. Corrective measures in these cases have always brought the red count up to normal within a short period of time.

*O & P examination of this man's stools revealed an ascaris lumbricoides infection.

Periodic blood counts and physical examinations have been performed during the last 12 months on the research personnel. In tables 2 and 3 results of the last examinations are noted. In respect to possible harmful actions of the radiations on the reproductive systems of the personnel involved, the following resume is enlightening: Out of 45 men, 20 are married and 10 have children or their wives are pregnant. In table 4 the individual's length of exposure to radar and the time their children were conceived in respect to their exposure to radar is noted. There are 10 cases of marriage in which there are no children, but in these cases there has always been a logical explanation concerning the wife's physical condition or contraception has been practiced.

TABLE 3.—*Physical examinations of exposed personnel*

Case No.	Abnormalities	Total alopecia	Serious illness	Symptoms due to radio frequency		
				Head-aches	Flushed feeling	Incr. heat of face or extremities
1.	None	None	None	No	No	No.
2.	do	do	do	Yes	No	No.
3.	do	do	do	Yes	No	No.
4.	do	do	do	No	No	No.
5.	do	do	do	No	Yes	No.
6.	do	do	do	No	No	No.
7.	Sinusitis, chronic	do	do	No	No	No.
8.	None	do	do	No	No	Yes.
9.	do	do	do	No	No	No.
10.	do	do	do	No	No	No.
11.	do	do	do	No	No	No.
12.	do	do	do	No	No	No.
13.	do	do	do	No	No	No.
14.	do	do	do	No	No	No.
15.	do	do	do	No	No	No.
16.	do	do	do	No	No	No.
17.	do	do	do	No	No	No.
18.	do	do	do	No	No	No.
19.	do	do	do	No	No	No.
20.	do	do	do	Yes	No	No.
21.	do	do	do	Yes	No	No.
22.	do	do	do	No	No	No.
23.	do	do	do	No	No	No.
24.	do	do	do	No	No	No.
25.	do	do	do	No	No	No.
26.	do	do	do	No	No	No.
27.	do	do	do	No	No	No.
28.	do	do	do	No	No	No.
29.	do	do	do	Yes	Yes	No.
30.	do	do	do	No	No	No.
31.	do	do	do	No	No	No.
32.	do	do	do	No	No	No.
33.	do	do	do	No	No	Yes.
34.	Accessory mammary gland	do	do	Yes	No	No.
35.	None	do	do	Yes	No	Yes.
36.	do	do	do	No	No	No.
37.	do	do	do	No	No	No.
38.	do	do	do	Yes	No	No.
39.	do	do	do	Yes	No	No.
40.	do	do	do	No	No	No.
41.	do	do	do	No	No	No.
42.	do	do	do	No	No	No.
43.	do	do	do	Yes	No	No.
44.	do	do	do	No	No	No.
45.	do	do	do	No	No	No.

In the course of this experiment another interesting fact was observed. The radar sets and antennae have a definite field of radio

frequency surrounding them when in operation, and when certain personnel work within these fields, various subjective symptoms are noticed by them:

1. A typical frontal headache located just over the bregma, and occasional intra-ocular pain. This is never very severe and usually occurs after some hours of exposure and disappears spontaneously one-half hour to an hour after exposure ceases. No medication has ever been necessary, and the headaches have never interfered with sleep.

2. The other symptom, which is not quite so common, is a flushed feeling of the face and a heating of the tissues of the hands when these are placed directly in the field.

TABLE 4.—*Marital status of exposed personnel*

Case No.	Married	Length of marriage	Number of children before exposure to radar	Pregnancies conceived during or after prolonged exposure to radar	Gynecological conditions affecting fertility
1.....	Yes.....	3 years.....	0	0	Uterine displacement.
2.....	Yes.....	22 years.....	3	0	
3.....	No.....	.....	.....	.....
4.....	No.....	.....	.....	.....
5.....	No.....	.....	.....	.....
6.....	No.....	.....	.....	.....
7.....	Yes.....	5 years.....	1	0	Chronic inflammation ovaries.
8.....	Yes.....	10 years.....	2	0	
9.....	Yes.....	1½ years.....	0	0	
10.....	No.....	.....	.....	.....
11.....	Yes.....	1 year.....	0	0	
12.....	Yes.....	2 years.....	0	1	
13.....	No.....	.....	.....	.....
14.....	No.....	.....	.....	.....
15.....	No.....	.....	.....	.....
16.....	No.....	.....	.....	.....
17.....	No.....	.....	.....	.....
18.....	No.....	.....	.....	.....
19.....	Yes.....	2 years.....	0	0	Hysterectomy.
20.....	Yes.....	½ year.....	0	1	
21.....	No.....	.....	.....	.....
22.....	Yes.....	1½ years.....	0	0	
23.....	No.....	.....	.....	.....
24.....	No.....	.....	.....	.....
25.....	No.....	.....	.....	.....
26.....	Yes.....	3 years.....	0	1	
27.....	No.....	.....	.....	.....
28.....	No.....	.....	.....	.....
29.....	No.....	.....	.....	.....
30.....	No.....	.....	.....	.....
31.....	Yes.....	16 years.....	2	0	(1).
32.....	Yes.....	18 years.....	0	0	
33.....	No.....	.....	.....	.....
34.....	Yes.....	¼ year.....	0	0	
35.....	Yes.....	½ year.....	0	1	
36.....	Yes.....	1½ years.....	0	0	
37.....	Yes.....	3 years.....	1	1	
38.....	Yes.....	2½ years.....	0	0	
39.....	No.....	.....	.....	.....
40.....	Yes.....	¼ year.....	0	0	
41.....	No.....	.....	.....	.....
42.....	No.....	.....	.....	.....
43.....	No.....	.....	.....	.....
44.....	No.....	.....	.....	.....
45.....	Yes.....	15 years.....	0	3	

¹ Hysterectomy performed during third pregnancy for uterine tumor.

This area of radio frequency is quite limited in its effect, i. e., it is apparently only noticed within 3 or 4 feet of a transmitter or antenna

that is working very efficiently at a peak load. The symptoms attributable to this were always mild. When compared with the standard diathermy outfits used in medical practice today, the output is quite low and inefficient.

Another question that has been raised by various reports from fleet activities is the possibility of alopecia due to the radiations. In all 45 subjects there is not one case of complete baldness and not more than the normal percentage of temporal and occipital thinning out of the hair due to age. In 2 cases there is a premature thinning of the hair which the individuals say has been progressive for years and is a familial characteristic. With these exceptions the average head of hair may be described as good.

SUMMARY

1. A group of 45 men with exposure to radar and high-frequency radio, varying from 2 months to 9 years, have been observed for the past 12 months.
2. Periodic physical and blood examinations of these individuals have been within the normal range.
3. The reproductive tissues do not seem to have suffered clinically any demonstrable damage, as judged by the number of conceptions and normal pregnancies during the time of exposure of the fathers to radar.
4. We have been unable to find any abnormal or premature alopecias that could be connected with exposure to radar.
5. There have been no unusual dermatological manifestations.

CONCLUSIONS

1. During the preliminary and present work on radar and high-frequency radio by personnel who are constantly exposed to the equipment and its emanations, both in a shielded and an unshielded condition, there has been no clinical evidence of damage to these personnel.
2. It is thought advisable that directives as to shielding of equipment and periodic medical checkup of personnel be continued to prevent a rather remote possibility of an occasional injury due to overexposure of personnel.
3. It is to be noted that the radio-frequency energy of radar is not different from that of other high-frequency radio or diathermy units of an equivalent average power.

The clinical laboratory work in this investigation was done by James Stewart Otto, pharmacist's mate, first class, U. S. N., and James John Lawson, Jr., pharmacist's mate, first class, U. S. N. R., who are both qualified laboratory technicians.

STUDIES ON THE IMPROVEMENT OF WOUND THERAPY BY THE USE OF SYNERGISTIC MIXTURES OF ANTI-BACTERIAL SUBSTANCES^{1 2}

LESLIE A. McCLINTOCK³

and

RAYMOND H. GOODALE

Commander (MC) U. S. N. R.

Investigation of mixtures of sulfonamides and urea in vitro and in vivo were begun some years ago at the Worcester City Hospital, after we had found that urea is a remarkable solvent for the sulfonamides. Experiments with a sulfapyridine-choleate complex (1), for which various solvents were being studied, had demonstrated that 1 percent of sulfapyridine would dissolve in a saturated solution of urea at pH 6. Further study of this solubilizing effect of urea on sulfonamides showed that the following approximate amounts of these drugs are soluble in a solution of 50 gm. of urea in 100 cc. of water at 30° C.: Acetyl-sulfanilamide 4.4 percent, sulfanilamide 8 percent, sulfathiazole 1.8 percent, sulfapyridine 1 percent, sulfaguanidine 2.6 percent, sulfadiazine 0.3 percent.

PRELIMINARY CLINICAL STUDIES

Clinical trial was started in certain infected wounds which local treatment with the sulfonamides had failed to help appreciably. Urea and one of the sulfonamides in solution were tried in osteomyelitis, infected surgical and traumatic wounds, streptococcic and staphylococcic sinuses and one case of thoracic empyema, all of which responded dramatically. The method by which the drug was applied was dependent upon the nature of the wound. In some cases the solutions previously mentioned were applied as wet packs and in others crystals were used. It was our impression that the presence of urea in these wounds aided the successful elimination of infection not only by virtue of the higher local concentration of sulfonamide which it makes possible, but by dissolving necrotic cellular protein, pus, and fibrin which hinder the penetration of the sulfa drug to the deeper sites of infection. It was also apparent that urea inhibits the inactivation of the sulfonamides, which

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² From the Bacteriology Department, Boston University School of Medicine, the U. S. Naval Hospital, Chelsea, Mass., and City Hospital, Worcester, Mass.

³ Research chemist, City Hospital, Worcester, Mass.

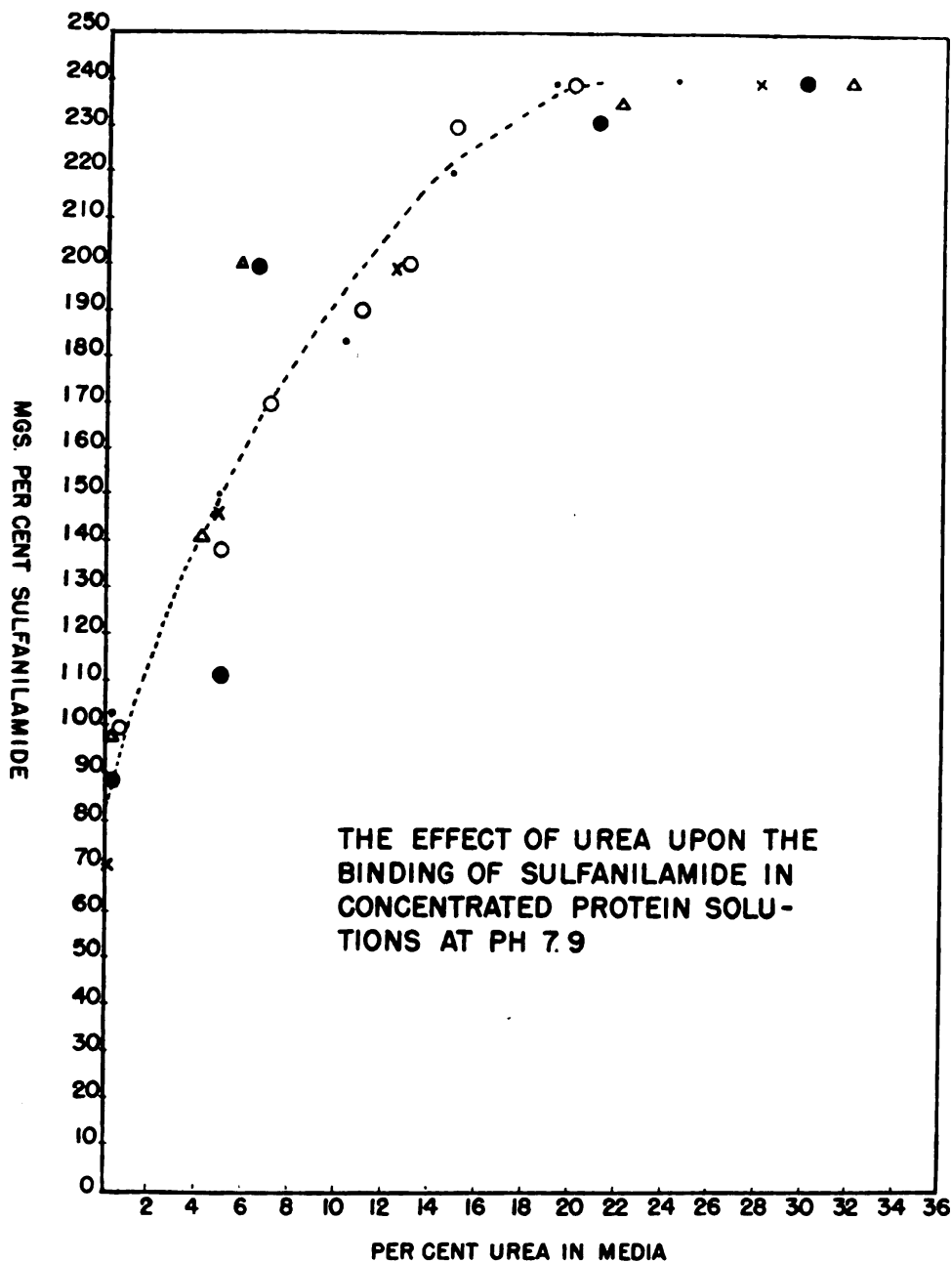
results from the presence of large amounts of foul pus and necrotic cellular protein. Our final drug of choice in these clinical trials was sulfanilamide, partly because of its very high solubility in urea but also because we believe that the best results were obtained with sulfanilamide, although we used sulfathiazole, sulfapyridine and later sulfadiazine and sulfaguanidine when these became available.

STUDIES IN VITRO

Antibacterial synergism of urea and sulfanilamide.—Experiments in vitro, employing sulfanilamide in albumin solutions undergoing digestion with trypsin at pH 8.0, demonstrated that a loose chemical conjugation takes place between the ring amine group in the sulfanilamide and the albumin, and also the products of early hydrolysis of the albumin. This union inactivates sulfanilamide's bacteriostatic property and seems to be more definitely chemical conjugation than physical adsorption, since chemical methods of detecting the theoretically free sulfanilamide by diazotization show interference with the reaction.

This conjugation can be demonstrated by a slight modification of the dimethyl-alpha-naphthylamine-diazo coupling reaction performed before the hydrolysis of the conjugated product takes place in the acid solution. The deterrent effect of urea upon this conjugation is marked, generally proportionate to the concentration of urea present, begins with 3 percent urea and is complete with 20 percent urea, at which concentration no conjugation can be demonstrated (chart 1). Attempts to grow organisms in this protein medium, containing more than 150 mg. percent of sulfanilamide, were without success. It was found that in these solutions a saprophytic organism would grow, in general, proportionately to the concentration of sulfanilamide conjugated. Conversely, growth of the saprophytic organism was inhibited in proportion to the amount of the active sulfanilamide present. In the presence of low concentrations of urea, which in themselves, were demonstrated to be below the concentration capable of inhibiting the growth of this organism in this medium, enough sulfanilamide was spared to produce bacteriostasis.

Other experiments with urea and sulfanilamide were conducted in vitro, in which we used meat infusion broth at pH 7.6 containing 1 percent dextrose. In these experiments it was found that the concentration of sulfanilamide, necessary to show a partial inhibition of the growth of a virulent strain of *staphylococcus aureus* (MK¹) for 18 hours but not for 24 hours, was 125 mg. percent. The amount of urea that would inhibit the growth of the same organism for the same length of time in this medium was 6 gm. percent. It was also observed that 2.5 mg. percent of para-amino-benzoic acid in this medium would inhibit completely the effect of the sulfanilamide.



Tubes containing these two threshold levels of sulfanilamide and urea (125 mg. percent and 6 gm. percent) were incubated with rather heavy inoculations of a 48-hour culture of this staphylococcus, along with concentrations of para-amino-benzoic acid ranging from 0.5 to 15 mg. percent. There was *complete* inhibition of growth in each of the tubes containing these concentrations of urea, sulfanilamide and para-amino-benzoic acid together. It was evident, therefore, that urea definitely spares sulfanilamide from inactivation by para-amino-benzoic acid and also enhances the activity of sulfanilamide

when used in high enough concentrations. It is of interest to note that subcultures of all tubes, showing no visible growth even after 96 hours (as in the case of sulfanilamide and urea), were positive. In a publication since this work Tsuchiya and associates (2), using *B. coli* adapted for growth in a synthetic culture medium, demonstrated that as little as 1.6 percent of urea suppresses the inactivating effect of methionine upon sulfadiazine. A somewhat analogous action of urea in inhibiting the growth-stimulating effect of riboflavin on *Lactobacillus casei* was observed by Isbell (3). He found that urea in amounts of 20 or more mg. per tube inhibited the growth-stimulating effect of riboflavin on *Lactobacillus casei*.

ANTIBACTERIAL SYNERGISM OF SUBSTITUTED PHENOLS AND SULFONAMIDES

Experiments in vivo and in vitro.—This synergistic effect of urea and sulfanilamide in producing a complete inhibition of bacterial growth in concentrations at which neither alone will inhibit growth suggested that possibly substances other than urea might produce a similar bacteriostatic synergism with sulfonamides.

Experiments in vitro and in vivo were immediately tried with two substituted phenols, 2-chloro-4-phenyl phenol and (3,4,5,6) tetrabromorthocresol,³ together with sulfanilamide and sulfathiazole. The studies in vivo were carried out at the United States Naval Hospital, Chelsea, Mass., where infected wounds were treated by local applications of a sulfathiazole preparation containing 1.6 mg. of tetrabromorthocresol per gm. of sulfathiazole. The infections treated showed immediate and rather dramatic response. The clinical course consisted of cessation of drainage within 24 hours, a drop in temperature to normal, followed by early healing of the wound. Sulfanilamide and urea in 1:3 ratio with 1.6 mg. tetrabromorthocresol per gm. was also used with the expectation that the urea might similarly spare the phenol from inactivation by the serum and cellular proteins.

Experiments in vitro consisted of determining the concentrations of 2-chloro-4-phenyl phenol and tetrabromorthocresol which would completely inhibit the growth of our MK¹ staphylococcus in heart infusion broth with 1 percent dextrose.

In the broth tubes we decided on the use of 125 mg. percent of sulfanilamide. This concentration would inhibit the growth of the MK¹ staphylococcus aureus grossly for 18 hours, but not for 24 hours in this medium (less than 10 percent inhibition of bacterial growth in

³ Because of the extreme insolubility of both 2-chloro-4-phenyl phenol and tetrabromorthocresol and the difficulty encountered in obtaining uniform aqueous solutions and suspensions, the more soluble choleates were synthesized. In these the ratio of 2-chloro-4-phenyl phenol to sodium desoxycholeate was 250:1,000 mg., the ratio of tetrabromorthocresol to sodium desoxycholeate was 100:1,000. The concentration of bile salt in the culture media in these experiments was far below the lowest level which would affect the growth of this organism.

24 hours). At the end of 24 hours, very little visible difference could be seen between the control cultures and the tubes with 125 mg. percent sulfanilamide, plus or minus 25 mg. percent of sulfanilamide making little difference in the gross aspects of the cultures.

In an experiment performed in triplicate, concentrations of 2-chloro-4-phenyl phenol ranging from 0.12 mg. percent to 2.4 mg. percent were used.⁴ The lowest concentration which would completely inhibit the growth of this organism for 24 hours at 37° C. was 0.96 mg. percent. This also was the lowest level which was bactericidal. The presence of 125 mg. percent of sulfanilamide had been previously shown to produce less than 10 percent inhibition of bacterial growth in 24 hours. However, with the addition of as little as 0.12 mg. percent of this phenol there was produced 80 percent inhibition and the addition of 0.24 mg. percent resulted in 100 percent inhibition.

To each of a series of test tubes containing the same dilutions of this phenol (0.12 to 2.4 mg. percent), 125 mg. percent of sulfanilamide and 2.5 mg. of para-amino-benzoic acid were added. This concentration of para-amino-benzoic acid was found by bacterial count to be sufficient to inhibit completely the sulfanilamide action. Since growth occurred in tubes containing concentrations of 2-chloro-4-phenyl-phenol below 0.96 mg. percent, this experiment confirmed the previously indicated synergism between sulfanilamide and this phenol.

It is also significant that subcultures of the tubes, which were negative for growth in the experiment with 2-chloro-4-phenyl phenol and sulfanilamide, were positive except in the case of those tubes containing a concentration of this phenol that in itself would ordinarily kill the organisms (0.96 or more mg. percent). This proves that the synergism between these drugs is restricted to bacteriostatic effect and does not apply to bactericidal action.

Similar experiments with tetrabromorthocresol showed that in the same medium and at the same temperature (37° C.) a concentration of 0.30 mg. percent of this phenolic compound would completely inhibit the growth of MK¹ staphylococcus aureus. In the presence of 125 mg. percent sulfanilamide, with as little as 5 micrograms percent (0.005 mg. per 100 cc.) of tetrabromorthocresol, there was a definite inhibition of bacterial growth, amounting to more than 35 percent in 24 hours. The medium was not *entirely* free from growth until a concentration of 0.070 mg. percent of tetrabromorthocresol was reached. With the minimal concentration of sulfanilamide used in this experiment, 50 mg. percent, a 60 percent inhibition of growth occurred in the presence of 0.05 mg. percent of tetrabromorthocresol.

⁴ In one experiment tyrothricin prepared from an alcoholic solution was used and in a recheck a urea solution of the drug was diluted to the proper concentration. The concentration of urea here was too slight to affect the course of the experiment.

TOXICITY STUDIES

Detailed animal studies revealing no evidence of toxicity from mixtures of tetrabromorthocresol, sulfanilamide, and urea will be the subject matter of a separate paper. However, the following is an example of the results in general of such studies: Tests conducted with tetrabromorthocresol, sulfanilamide, and urea consisted of implanting intraperitoneally in rabbits 3 gm. of sulfanilamide with 300 mg. of tetrabromorthocresol, and 3 gm. of sulfanilamide alone in the control group. Other animals received intraperitoneal implants of 3 gm. of 1:3 mixture of sulfanilamide and urea and also with 300 mg. tetrabromorthocresol.

In no instance did any signs of local or systemic toxicity develop from the phenol. In all cases implanted with urea-sulfanilamide there was grossly not as extensive a foreign body reaction as occurred in those animals that received sulfanilamide alone. In about 50 percent of the animals implanted with sulfanilamide, with and without the phenol, a rather serious local reaction was visible. In these cases the drug was found in the peritoneal cavity enmeshed in fibrin as long as 72 hours after implantation, and on histologic examination it was evident that in all cases the sulfanilamide gave rise to a local inflammatory reaction characterized by diapedesis of polymorphonuclear neutrophils. The rate of absorption of sulfanilamide in the presence of urea was greater in proportion to the amount of local sulfanilamide than when urea was not present. Actually this increased absorption was slight. The average rate of sulfanilamide absorption into the blood stream of animals treated with urea-sulfanilamide averaged 10 mg. percent in 6½ hours as compared with a concentration of 2.5 mg. percent reached in the control animals receiving 3.0 gm. of sulfanilamide alone.

TISSUE DIFFUSION STUDIES IN VITRO

Experiments in vitro to determine the effect of urea upon the rate of diffusion of sulfanilamide through living and dead tissues were carried out with the use of strips of abdominal muscle (maximus) of the rabbit. These pieces of tissue were cut from rabbits killed by trauma and were all prepared in similar thickness (1.3 mm.). The tissue-strips were cut to uniform size, and one-half of these were immersed in a 2-percent solution of sodium cyanide for 15 minutes to kill the cells. They were then washed and allowed to soak in sterile saline for 30 minutes. The strips treated in this manner will be referred to as dead tissue. The living (untreated) and dead (treated) tissue-strips were fastened to flanged glass tubes 2 cm. in diameter and made watertight by binding with soft copper wire to form drumheads. Solutions of 150 mg. percent sulfanilamide were then prepared in saline, in 20 percent urea in

saline, and in 40 percent urea in saline. Equal amounts of these solutions were added to the dialysis tubes, which were then placed in saline solutions. Samples of the dialysates were taken every 30 minutes for 4 hours. The results of these experiments showed that the diffusion of sulfanilamide through living tissue takes place very slowly, 1.4 mg. percent in 4 hours, while practically none diffuses through dead tissue.

The effect of urea upon diffusion through tissue is to increase the rate. This greater rate of diffusion occurs in both living and dead tissue. After four hours in the case of the 20-percent urea solution, the dialysates from the cyanide-treated strips showed 8 mg. percent sulfanilamide, and the living tissue dialysates contained 4 mg. percent. Forty percent urea had a similar effect but on a lesser scale, 3 mg. percent of sulfanilamide being present in the living tissue dialysates and 4.5 mg. percent in the dead tissue dialysate after four hours. A repetition of this experiment, using increasing concentrations of urea, viz., 10, 20, 30, and 40 percent showed the same results as were obtained previously, and are recorded below.

Dialysis through living tissue occurred as follows: After three hours sulfanilamide alone showed 0.2 mg. percent present in the dialysate; 10 percent urea caused 2.8 mg. percent of sulfanilamide to diffuse through; 20 percent urea produced a diffusion of 3 mg. percent; 30 percent urea produced an even greater diffusion of 3.8 mg. percent; 40 percent effected a diffusion of 3.9 percent.

Dialysis through the cyanide-treated tissues was as follows: After three hours the tubes containing sulfanilamide alone showed a diffusion of 0.3 mg. percent; 10 percent urea produced an increase in the diffusion of sulfanilamide to 8 mg. percent; 20 percent urea increased the diffusion to 10.8 mg. percent; 30 percent urea allowed 11 mg. percent; 40 percent urea decreased the rate of diffusion so that only 4 mg. percent diffused through the membrane in 4 hours.

CONCLUSIONS

1. It appears that urea and certain phenols act synergistically with sulfanilamide to produce inhibition of bacterial growth in concentrations far below the lowest effective bacteriostatic level of each alone.

2. Urea not only aids the bacteriostatic effectiveness of sulfanilamide but it spares the sulfonamide from chemical conjugation with albumin and its degradation products and from inactivation by para-amino-benzoic acid.

3. Urea greatly aids the transportation of sulfanilamide through both living and dead tissue at a far greater rate than these substances are capable of diffusing by themselves.

4. The solubilizing effect of urea on sulfanilamide, its inactivation of sulfonamide inhibitors and the synergistic bacteriostasis of certain

phenols with sulfanilamide suggest that the advantages observed experimentally with mixtures of these three compounds merit extensive clinical trial.

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DIET AND DENTAL HEALTH

The oral cavity, unlike other parts of the body, may not only be affected by the nature of food that is digested and assimilated; it may also be affected by the food residues in the mouth. While such residues contribute nothing to the nutrition of the body, they may contribute much to the degeneration of the teeth, particularly if bacteria act upon the residues to produce acids.

That sugar and other refined carbohydrates are apt to promote tooth decay has been indicated by many studies in schools and other institutions and also by the observation that primitive Eskimos were free from decay until "civilized" foods were introduced, by traders. These foods were mainly sugar, molasses, and refined flour.

If we could improve national food habits, tooth decay and gum disease, including pyorrhea, could be reduced for the population at large. To do this, there must be a more widespread recognition of the importance of a diet including generous amounts of the various foods suggested in the dietary pattern. The right kind of food is essential to health, including dental health.

However, an adequate diet in itself is no absolute guarantee against tooth decay. Many times, caries occurs in spite of the fact that the individual or the family attempts to maintain an adequate diet.—Radusch, D. F.: Diet and dental health. J. Am. Dent. A. 30: 588-593, April 1, 1943.

THE FUNGI GO TO WAR¹

ARTHUR P. R. JAMES

Lieutenant Commander (MC) U. S. N. R.

The very high incidence of disability among our armed forces due to dermatomycosis of the feet and its complications makes this condition of major importance. Every effort must be made to control this condition in its early comparatively mild form. Most individuals maintain such a high degree of immunity that fungi exist on their skin in a practically saprophytic state. Since, thanks to this immunity, the great majority of cases of dermatomycosis of the feet tend to respond readily and clear up under almost any or no treatment, there is an almost universal tendency for both the public and the profession to regard the condition lightly. In tropical climates and under war conditions they are playing with fire.

Fungi thrive in the heat and moisture of tropical climates. In many areas adequate facilities for bathing are entirely lacking, resulting in the accumulation of macerated debris between the toes. Fungi responsible for dermatomycosis can live only on dead tissue and such macerated debris supplies an excellent medium for their propagation. The tension of war increases the incidence of dysidrosis and this in turn changes the local condition of the skin favoring fungi. Undoubtedly dietary factors play an important role in the maintenance of resistance to dermatomycosis. Finally, foot strain, hyperidrosis, improper footwear and long and hard marches all tend to lower resistance to fungus infection.

Two types of reaction may occur as the result of the growth of fungi. One, local due to irritative contactant changes similar to a venenata, and the other an "ID" phenomenon due to an allergic reaction to the products originating from fungi. These latter lesions are termed dermatomycids. They are vesicular and are commonly seen on the hands but may become generalized. This generalization is seen commonly in patients from the tropics but is comparatively rare in this country.

Since dead tissue is essential for the growth of fungi it is obvious that thorough cleanliness affords the best prophylaxis. Foot powders containing salicylic acid, aluminum chloride, etc., are valuable in this country and climate but are useless in the tropics since they immedi-

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ately become a wet sticky mess in the shoes. Ointments containing salicylic acid, benzoic acid, mercury, etc., if used for any considerable time, lower the resistance to secondary infections. Their use, except for short periods of time, is to be condemned. Routine use of a solution containing salicylic acid, 2 to 5 percent, glycerin 2 percent, in ethyl alcohol would definitely offer security in a large percentage of cases. Routine fumigation of shoes using formaldehyde in closed containers will result in a large number of cases of dermatitis venenata, unless great caution is exercised, since sensitivity to formaldehyde is common.

The all-too-common practice of diagnosing all dermatoses of the feet as dermatomycosis is most strongly to be condemned. An expert can usually make a definite clinical diagnosis but, where facilities permit, the diagnosis should be confirmed by microscopic examination. Dozens of species of fungi are known to be responsible for the various dermatomycoses. The determination of the exact species is of no practical value in the therapy of a given case. It is well to keep in mind that macerations between the toes may closely simulate fungus infection. Dermatitis venenata is commonly seen. It tends to involve mainly the dorsal surface of the feet and it will be definitely aggravated if it is incorrectly diagnosed and treated as a dermatomycosis. Finally dysidrosis must be considered along with other nonfungus infections.

Under ordinary circumstances, unless the condition is severe, an uncomplicated dermatomycosis of the feet produces discomfort and pruritus but little or no disability. Three disabling complications are commonly encountered:

1. Secondary infection which is usually due to both staphylococcus and streptococcus causes the affected parts to become swollen and acutely inflamed. Deep-seated vesicles and pustules occur. Phytids usually appear on the hands and soles of the feet. A localized cellulitis and, occasionally, lymphangitis may occur and there is usually considerable constitutional disturbance.

This complication is treated by continuous wet dressings. Any one of three solutions are satisfactory for the wet dressings:

1. Burow's solution, strength 1:30.
2. Bichloride of mercury 1:20,000.
3. Saturated solution of boric acid.

All vesicles and pustules must be opened wide and often. Sulfonamide therapy is valuable. It should be given internally and not employed locally because of the danger of sensitizing the patient's skin. As soon as the secondary infection is well under control, the treatment is changed to include fungicides.

2. Dermatitis venenata which is usually the result of sensitivity to some topical application used in the treatment of the dermatomycosis, is our commonest complication. The condition is usually most marked over the dorsal surface of the foot and tends to spread rapidly to involve the ankle. The affected area is acutely inflamed and covered with vesicles. The pruritus is marked.

This complication is treated with continuous wet dressings of 1:30 Burow's solution until the acute stage is brought under control. If available, x-ray therapy is of value. Later calamine lotion with phenol and menthol at 1 percent is used until all evidence of the venenata is gone before treatment is directed against the fungus infection.

3. Dermatomyoids appearing on the hands and feet, the result of an allergic reaction to the products of fungus growth, may cause considerable trouble. The routine use of intradermal injections of trichophytin in the management of this allergic reaction is not advocated. This procedure requires considerable time and in most cases the results are questionable. These lesions will disappear spontaneously as soon as the fungus infection itself is brought under control. The vesicles should be incised and the affected parts treated the same as a venenata. X-ray therapy, if available, is most valuable.

The routine employed in the treatment of dermatomycosis must not only be effective, it must also be well tolerated. Since this article is written largely for medical officers of the armed forces, two other important factors must in addition be considered. The drugs recommended must be readily available and the mode of employment simple and rapid. Iodine has long been recognized as one of our strongest fungicides but the use of the tincture in the strength required produces severe irritation. For the past 15 years we have employed iodine crystals in benzene. Since entering the Navy xylene (xylol has been substituted for benzene. It is readily available and is an excellent solvent for iodine and fats. Because of this action it tends to penetrate into the depths of the skin. Two-percent iodine crystals in xylene should be applied twice daily to the affected areas. Even denuded areas will tolerate this application with little discomfort. No cases of sensitivity have been seen in a large series of cases. This solution may be employed in the treatment of mycotic infections in other areas but if applied to tinea cruris there is a temporary sensation of severe burning which may be allayed by a liberal use of talcum powder. The solution should not be applied to the scrotum.

The physician will little err who makes haste slowly in the management of dermatoses of the feet. A safe and sane practice would include the immediate use of a bland wet dressing such as 1:30 Burow's solution as a routine measure for all acute cases.

ERRORS IN ISO-AGGLUTINATION TESTS ¹

BARTLETT C. SHACKFORD

Commander (MC), U. S. N. R.

Cross-matching of blood specimens of potential donors and patients in local civilian hospitals has disclosed several instances in which the donor's stated blood group proved to be incorrect. Because most of the donors were Navy men whose health records and identification tags were marked with an erroneous group, it has been deemed advisable to bring the matter to the attention of the Medical Department. Donors whose identification cards or tags listed a blood group proven to be wrong have been obtained from several different naval establishments, from the Army, and from large manufacturing organizations. The potentialities for disaster from such mistakes are too obvious to require comment.

TABLE I

Subject	Group	Agglutinogens (cells)	Agglutinins (serum)	Specimen	Serum dilutions							
					1:1	1:2	1:4	1:8	1:16	1:32	1:64	1:128
L	B	B	a	Serum	}	+	+	+	+	±	0	0
H	A	A	b	Cells								
L	B	B	a	Serum	}	±	0	0	0	0	0	0
K	AB	A, B	0	Cells								
V	B	B	a	Serum	}	+	+	+	+	+	+	±
H	A	A	b	Cells								
V	B	B	a	Serum	}	+	±	0	0	0	0	0
K	AB	A, B	0	Cells								
S	A	A	b	Serum	}	+	+	+	+	+	+	±
L	B	B	a	Cells								
S	A	A	b	Serum	}	+	+	+	+	+	+	±
V	B	B	a	Cells								
G	O	O	a, b	Serum	}	+	+	+	+	±	0	0
K	AB	A, B	0	Cells								
H	A	A	b	Serum	}	+	+	+	+	+	+	±
L	B	B	a	Cells								
H	A	A	b	Serum	}	+	+	+	+	+	±	0
V	B	B	a	Cells								
H	A	A	b	Serum	}	+	+	+	+	+	+	±
K	AB	A, B	0	Cells								

It is the practice in naval laboratories to use blood from hospital corpsmen who are known to be in group A or group B in making iso-agglutination tests. The civilian laboratories use high-titer com-

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mercial sera, both human and rabbit. Study of the situation in the Long Beach Naval Dispensary laboratory disclosed the fact that one corpsman, whose health record and tag were marked group B, was in reality in group AB.

It is not believed that these are clerical errors. Titration of the sera of the corpsmen employed as technicians in the laboratory of the Long Beach Naval Dispensary has revealed considerable variation, both in agglutinogens and agglutinins, as indicated in table 1. Study of this table discloses that corpsman K, whose identification tag and health record classed him as group B, reacted as a group AB. The cells showed partial agglutination when used undiluted with the serum of corpsman L, and agglutination to 1:2 with the serum of corpsman V. K's cells were agglutinated strongly by both A and B human sera and rabbit sera of one commercial firm. With another commercial human serum, reaction was fairly strong with B but weak with A. Subsequent tests have resulted in classifying corpsman K as group A₂B, a group in which the agglutinating property of the A₂ component is notoriously weak. Corpsman K's cells were agglutinated to 1:128 by a known group A serum; and to 1:32 by that of a known group O, indicating that K's cells are not deficient in agglutinin B. Further study of the table will reveal that of the two known group B corpsmen, only V has blood of a titer sufficient to make it suitable for use in classifying unknown bloods. Blood used for this purpose should have a titer of at least 1:20, and better if 1:40.

It is believed that one cause of errors in blood grouping is the use of low titer sera in testing. Such sera, if they react at all, react slowly and weakly. In testing large numbers of men the tendency is to wait an insufficient length of time to permit the weak sera to react. Sera should be observed for at least an hour. Because the large number of tests performed in military practice make a slide method the most practical one, the technician should use a method which precludes the possibility of errors through drying of sera. The drop of cells and serum should be ringed with vaseline and covered with a cover glass; and the result should be observed with the microscope. To avoid errors due to "cold" agglutination, sera and cells should be at room temperature.

SUMMARY AND CONCLUSION

Discovery and study of several men from various Navy, Army, and civilian activities whose identification records bore erroneous blood groups suggest the following recommendations:

1. All technicians doing blood grouping must be thoroughly instructed in the theory as well as the practice of the method. They must understand the importance of subgroups; of the extreme care necessary to avoid errors; and of the seriousness of the consequences.

2. Only high titer serum should be used in making iso-agglutination tests, preferable 1:40 at least. Sera of unknown titer should not be used.

3. A technic should be employed which permits observing the reaction for at least an hour.

4. No health record or identification tag of any individual in any service may be assumed to carry the correct blood group. Every case must be retested and cross-matched before receiving or giving a transfusion. If this is not practicable, plasma or serum should be given the patient in preference to whole blood.



CONTROL OF EPIDEMIC MENINGITIS ON A TRANSPORT

The means by which an outbreak of meningococcal meningitis was apparently stemmed aboard our transport was so simple, and yet so effective, as to seem to justify publication. It would seem readily applicable in schools, barracks, camps, etc., as well as ships.

Our first case was a fulminating one, reporting to sickbay at 0900. during a violent storm, having taken sick the previous afternoon. By 2330 the patient was dead and, although signs of meningeal irritation and cerebral disturbance had been recognized, the cause of death was not proven until a cisternal puncture was performed postmortem. The fluid was cloudy, and gram-negative intracellular diplococci were apparent.

Three main steps were used to endeavor to stop the spread of the malady through the ship, where living conditions were really ideal for its transmission:

1. Every man on the ship (*approximately 1,600*) was immediately given 30 to 45 grains of one of the sulfa drugs; i. e., sulfanilamide, sulfadiazine, or sulfathiazole. This seemed like a small dose, possibly a waste of good drugs at the time, but, nevertheless, was apparently worth while.

2. Daily temperatures were taken on every man on the ship. This required some time, but by using about 20 thermometers and about half as many corpsmen and by having the men traverse a certain section of the ship during the procedure it was facilitated.

3. All men showing a temperature of 99° F., or over, were given additional sulfa therapy (principally sulfadiazine, approximately 90 grains in 24 hours). These men were kept under observation, and a few were hospitalized.

Two additional cases were encountered, both following very closely, or occurring almost simultaneously with the first. Spinal punctures on two other patients with signs of meningeal irritation proved negative.

Although living conditions for this group of men were soon materially improved, which may have been a large factor in the cessation of the epidemic, we felt that the measures taken were worth while and well worth further trial.—Malloy, F. D., Lt. Com. (MC) U. S. N. R.; Ellwood, P. M., Lt. Com. (MC) U. S. N. R.; and Crouch, W. B. Lt. j. g. (MC) U. S. N. R.

IMPACTED CERUMEN¹

INCIDENCE AND MANAGEMENT

JAMES E. LEBENSOHN

Commander (MC) U. S. N. R.

Impacted cerumen is a subject of such apparent simplicity that it receives only cursory attention in medical literature, but the prevalence of the condition merits further discussion. In a representative section of the male population examined at Officers' Procurement Service, 1 in 9 individuals had an occluding amount of wax in one or both ears. On the other hand, a graduating class of reserve midshipmen, who had benefited from naval medical supervision for the previous 3 months, showed a much lower ratio, 1 in 26. A more detailed analysis of the amount of wax in these ears is given in table 1. In each group the distribution of cerumen was symmetrical in consistency, amount, and color in 90 percent of the cases.

CHARACTERISTICS

Cerumen is secreted continuously but in very small amounts by the thousand or more modified sweat glands located in the skin of the cartilaginous meatus, the outer third of the aural canal. The freshly secreted product is a semisolid, light-yellow substance which is nor-

TABLE 1.—Incidence of wax in ears

Ears examined	Reserve midshipmen, 794	Officers' procurement, 3,258	Ears examined	Reserve midshipmen, 794	Officers' procurement, 3,258
Wax in negligible amount.	643	2,752	Wax in occlusive amount	20	252
Percentage.....	81	84.5	Percentage.....	2.5	7.7
Wax in moderate amount.	131	254	Bilateral (individuals).....	5	70
Percentage.....	16.5	7.8	Only right ear.....	8	54
Bilateral (individuals).....	46	71	Only left ear.....	2	54
Only right ear.....	17	62			
Only left ear.....	22	50			

mally conveyed along the auditory canal to its exit by the movements of the lower jaw in eating, talking, or yawning. The discharge of the cerumen as brownish-white flakes is probably facilitated by the head movements in sleep, since wax tends to accumulate least in the side favored in sleeping. Cerumen functions as part of the protective mechanism of the ear and, together with the meatal hairs and the

¹ Received for publication January 7, 1943.

tortuosity of the canal, tends to impede the entrance of dust and insects to the deeper meatus.

Fresh cerumen consists of a variable amount of water, fats, free fatty acids, cholesterin, and lecithin. As cerumen has no germicidal action, progressive contamination with vegetable spores and bacteria (especially diphtheroids) soon ensues, which increases with the age of the wax. Embedded in old cerumen are also desquamated epithelial cells, aural bristles, and dust. In the aural wax of brass finishers particles of brass have been demonstrated, and in that of coal heavers, coal dust. The admixture of dust seems to favor wax accumulation, since women, whose ears are protected from dust by their long hair, are less troubled in this respect.

The intensity of cerumen secretion is affected to some extent by the same factors that influence perspiration. John Gunther² writes: "Chinese do not perspire; they have no ear wax and very little bodily hair." In most cases the accumulation of wax is determined by conditions causing an interference in the normal discharge. As the mass increases it hardens and darkens, so that the brown sticky material becomes dense and black, sometimes with a grayish overcast of desquamated cells. Impacted cerumen is most frequent in adults. Children sometimes place small pebbles or other foreign bodies in the aural canal which may be discovered years later as the nucleus of a cerumen plug. Pus destroys wax, and suppurative ears are consequently free from cerumen. In otosclerosis, wax is rarely present, which is possibly due to the metabolic disturbance in this condition.

SYMPTOMS

Wax in the ears is often discovered in routine examinations quite to the surprise of the person examined, since the condition is symptomless as long as a slight crevice remains through which sound can reach the inner ear.³ The presenting symptom of an occluding plug is usually a sudden impairment of hearing, which may be accompanied by tinnitus and autophony. Many with impaired hearing from tubal catarrh or other disturbance ask to have wax removed, but those who become suddenly deaf from wax have no intimation of the cause unless they have had this experience previously. The swelling of the hygroscopic mass is often precipitated by the entrance of moisture, and so the disturbance is frequently attributed to "water in the ears."

Some degree of otitis externa is commonly present, which may be primary, since the branny scales of seborrhea sicca favor wax accumulation, or secondary from the desquamative inflammation induced by

² Gunther, J.: *Inside Asia*. p. 285. Harper & Bros. New York. 1939.

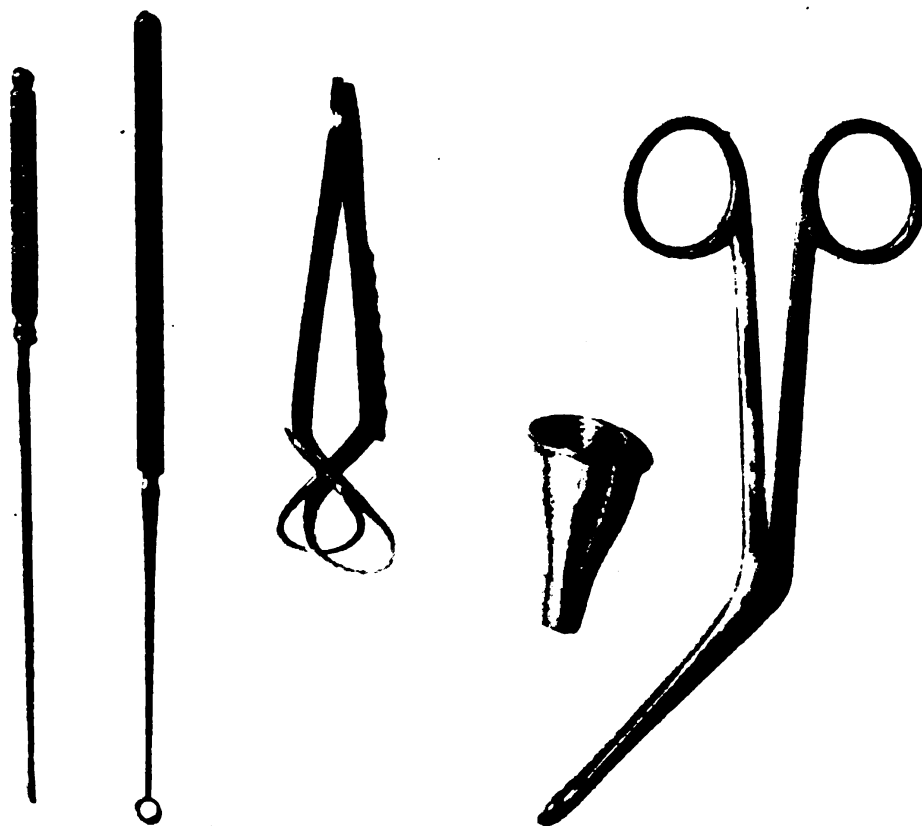
³ "It's an ill wind that blows no good". Among naval personnel ceruminous plugs not infrequently have protected ears from the disturbing effects of gunfire. Though commonly used, cotton wool alone is inadequate for this purpose, but *when dipped in mineral oil* it is an effective safeguard.

the cerumen plug. Distressing symptoms may result from the otitis externa, or from the patient's own manipulations in endeavoring to clean the aural canal. Particles of wax may be thus displaced against the drum membrane, producing tinnitus and discomfort; or a plug of cerumen may be pushed beyond the isthmus, causing reflex cough and even vertigo. Furunculosis is not an uncommon sequel from the hairpin, toothpick, fingernail, or paperclip, used to remove wax or allay the associated aural irritation.

TREATMENT

The less personal attention the aural canal is given the better. Wax can be safely and effectively removed only by one who knows what to do and sees what he is doing. Cleaning the aural canal with the twisted end of a wetted towel serves but to swell and clump the wax and so actually favors accumulation instead of preventing it.

Methods of removing cerumen are determined by the amount present. A thin film is easily wiped off with a cotton-wound applicator dipped in alcohol. Moderate accumulations that only partly obstruct the canal can be conveniently removed with a delicate Hotz spoon or blunt Buck curette (fig. 1). The wax must be separated from the canal wall with care to avoid injury to the skin and consequent pain



1. SOME RECOMMENDED INSTRUMENTS FOR MANAGEMENT OF IMPACTED CERUMEN. LEFT TO RIGHT: HOTZ SPOON, BUCK'S BLUNT RING CURETTE, TOWEL CLIP, AURAL SPECULUM, AND AURAL FORCEPS.

and bleeding. Adherent crusts can be softened by a few minutes' contact with a tampon soaked in hydrogen peroxide or acetone. If necessary to use these instruments near the drum, one should remember to start at the upper posterior section where the tympanum is nearest the meatus, and displace the mass downward and forward.

A large occluding plug should be removed with a syringe except when a perforation of the drum membrane is known to be present. The most useful syringe is the 5-ounce all-metal type, with a long thin tip that enters the canal without obstructing the view. To insure smooth working the plunger and barrel should always be separated when not in use. Ordinary warm water at 100° F. is effective, but the addition of sodium bicarbonate, 1 to 2 teaspoonsful to the pint, probably adds to its efficiency. The patient should be covered with a suitable drape—that of plastic material is excellent—and as a further precaution against wetting, a folded towel is clipped around the neck. The patient, with the hand of the opposite side, holds a curved basin below the ear and tightly against the skin, shown in figure 2.



2. REMOVAL OF CERUMEN BY SYRINGING. NOTE 5-OUNCE ALL-METAL SYRINGE USED. WETTING OF PATIENT IS PREVENTED BY PLASTIC DRAPE. AND THE HOLDING OF THE CURVED BASIN BELOW AFFECTED EAR BY CONTRALATERAL HAND. THE OPERATOR IS PROTECTED BY A LABORATORY APRON.

In using the syringe the nozzle must be first held upright and all air expelled. The auricle is then drawn backward and outward to straighten the canal, and the stream is directed, not at the wax, but along the upper part of the posterior wall. The water does not dissolve the wax but insinuates itself between the wax and the canal until the plug is finally pushed out by the force of the water behind it. If syringing is ineffective, the wax should be gently separated from the meatal wall with the Hotz spoon, and the process repeated. If a loosened epithelial cast is seen, it should be carefully dragged out, as sometimes the plug comes with it.

Very occasionally the wax is so hard and adherent that it does not budge even after arduous effort. For such cases a wax-softening preparation should be prescribed, such as 3 percent sodium carbonate in equal parts of glycerin and water, the solution to be dropped in the ear canal several times daily and the ear plugged with cotton. After a few days the wax can usually be removed without difficulty.

After the syringing is completed the canal should be dried with absorbent cotton and excoriated surfaces dusted with boric acid powder. Stauffer⁴ has observed that the earphones used by airplane pilots, radio and telephone operators, tend to dislodge particles of wax against the drum membrane. After the canal is cleaned and dried, he inserts a pea-sized portion of the following ointment with an applicator: Salicylic acid, 2 percent; precipitated sulphur, 5 percent; in petrolatum. This ointment also allays itching and is excellent for the scaly dermatitis often present.

⁴ Stauffer, H. B.: Ear conditions in pilots and radio operators. *J. Aviat. Med.* 12: 160, 170, June 1941.



ANAL FISTULA AND REGIONAL ILEITIS

An anal abscess or anal fistula is frequently the factor which will bring a patient with regional ileitis to his physician.

If the patient is a young adult with any vague intestinal disturbance, the presence of an anal fistula or the history of an abscess or fistula should lead the clinician to investigate the small bowel for regional ileitis.

Any patient who has an anal fistula is entitled to a proctoscopic examination and, if abdominal symptoms coexist, the roentgenologic examination of the large and small intestine.

Regional ileitis should be considered as a possible cause of any extrarectal mass of undetermined cause.—Jackman, R. J., and Smith, N. D.: Some manifestations of regional ileitis observed sigmoidoscopically. *Surg., Gynec. & Obst.* 76: 444-445, April 1943.

NEUROPSYCHIATRIC CLINIC AT A NAVAL CONSTRUCTION TRAINING CENTER¹

STANLEY M. DILLENBERG
Lieutenant Commander (MC) U. S. N. R.

and

BERNARD LOCKE
Lieutenant H-V(S) U. S. N. R.

With the origin of the "Seabees" something less than a year ago, there arose a rather novel situation in Navy recruiting. For the first time the Navy began organizing a large number of highly skilled tradesmen for a definitely specialized type of activity.

Due to the select nature of the group and because of its higher mean chronological age we feel that the distribution and nature of the neuropsychiatric problems found may differ from those usually found in a naval receiving or training station. It is for this reason that we are presenting our findings during the first 6 months of the clinic's operation.

The neuropsychiatric clinic was formed at Camp Allen in May 1942. Since that time its personnel has consisted of a neuropsychiatrist, a psychologist, and a yeoman. Because of the extremely large number of recruits passing through the station and our limited personnel, it was found impossible to interview each man as he came through the receiving line. Consequently it was decided to depend on cases referred to the clinic during the training period of six to eight weeks allotted to each man. All departments involved in handling the men during their stay in Camp Allen or Camp Bradford were aware of the clinic's existence and its desire to see all men who were experiencing undue difficulty in falling into the activities of their group, as well as men who were constant visitors to battalion sickbays, were bed wetters, etc. In addition, problems were referred to the clinic by the battalion medical officers. The commanding officer likewise directed to this department all suspicious cases appearing at mast.

It is quite probable that many cases were missed which might have been picked up if each recruit had been interviewed by this department. However, the policy of having every case causing suspicion in the minds of the regimental training and medical officers referred to us, brought forth many that assuredly would have been missed in a short interview on the examining line.

During the interval with which we are dealing there were 668 patients referred to the clinic for study. This number does not in-

¹ Received for publication November 25, 1942.

clude those examined for intellectual suitability for elective surgery, and does not include revisits of individuals for rechecks or minor psychotherapy.

The disposition of these 668 cases is given in table 1:

TABLE 1.—Disposition of cases seen by N-P department

Cases seen but not discharged from the service.....	341
Cases seen and discharged from the service.....	255
Cases transferred to hospital for discharge.....	72
Total.....	668

The prime function of the N-P clinic is to discharge from the naval service those individuals who are unfit because of a neuropsychiatric disorder. Of the 668 subjects examined by the N-P clinic, 255 were discharged from the naval service. Table 2 shows the various diagnoses attached to the discharges of the subjects.

Sixty-eight cases of enuresis were sent home. This is 26.6 percent of all the cases discharged. In many cases we had the mattress and the bedding examined to verify the patient's story. No case was discharged on history alone, the patient had to wet his bed at least once while in camp. It was in this group, however, that we lost some excellent naval material. These men were well educated, expertly trained, and extremely anxious to do their duty and remain in the Navy. Many of these subjects consciously withheld the information of their enuresis from the recruiting officer due to their desire to get into the Navy. Many others just "slipped by." We used as much care as possible in evaluating the enuretic history of these subjects. It was felt, however, that if a subject would deliberately wet his bed to evade naval service, he was not the type of individual we wanted. Fourteen of the cases of enuresis occurred in the one Negro battalion that was formed. This made the incidence of enuresis among the Negroes some 40 times greater than among the whites.

Thirty-six men were eliminated for mental deficiency. This is 14.1 percent of all the cases discharged. Twelve of the 36 men were Negroes. Since the proportion of the Negroes to the white men who came through during this interval was roughly 1 to 40, the incidence of mental deficiency in the Negro group was almost 20 times as great as in the whites. These mental defectives were eliminated after a careful clinical evaluation of their performances on acceptable measures of intelligence such as the Bellevue adult scale of intelligence or the Terman-Merrill revision of the Binet, and an evaluation of their social and economic backgrounds. A mental age of $9\frac{1}{2}$ to 10 years for the Negroes and $10\frac{1}{2}$ to 11 years for the whites was usually considered as the lowest acceptable level for retention in the service.

TABLE 2.—*List of reasons for discharge*

Acromegalia.....	1
Alcoholism, chronic.....	27
Arteriosclerosis, cerebral.....	2
Constitutional psychopathic states:	
Emotional instability.....	7
Inadequate personality.....	11
Paranoid personality.....	1
Sexual psychopathy.....	2
Dementia paralytica.....	1
Drug addiction.....	1
Encephalitis.....	2
Enuresis.....	68
Epilepsy:	
Grand mal.....	31
Petit mal.....	5
Glioma.....	1
Hypochondriasis.....	3
Mental deficiency.....	36
Migraine.....	10
Narcolepsy.....	1
Neuritis:	
Brachial.....	1
Sciatic.....	1
Post concussion syndrome.....	2
Post traumatic encephalopathy.....	2
Psychoneurosis:	
Anxiety neurosis.....	6
Compulsion neurosis.....	1
Hysteria.....	17
Neurasthenia.....	5
Somnambulism.....	10
Total.....	255

Epilepsy was the next most frequent cause for rejection. These cases were most frequently picked up when they had a seizure while in camp which was reported by an eye witness. Practically all epileptic subjects did everything in their power to conceal their history of seizures and would not volunteer the information of their own accord. It is very possible that some epileptics have gone out with battalions, as the men are only kept in this camp from 6 to 8 weeks and it is not infrequent for longer periods than that to elapse between seizures. This, unfortunately, cannot be avoided. Thirty-six men were eliminated for epilepsy—31 for grand mal and 5 for petit mal. This is 12.1 percent of the total number of men surveyed. Frequently eye witnesses of the seizures were called to give descriptions. Red Cross investigation was also done on a number of cases to determine authenticity of statements.

Due to the older age group of men examined a much higher incidence of chronic alcoholism was found than is seen in most training stations.

Twenty-seven men were sent home for this reason. This is 10.6 percent of all cases discharged. Discretion was used in eliminating chronic alcoholics. If a man was a steady, constant imbibor but always worked hard, never lost a job because of drinking, had never been in conflict with the authorities, and apparently would be valuable to the Navy, we would be inclined to keep him on probation. Our tendency was toward leniency. On the other hand, if the subject was a heavy drinker, was arrested frequently because of ethylism, tried several cures without success, gave up or lost jobs because of drinking, or went A. O. L. or A. W. O. L. on several occasions, he was discharged from the Navy. Or if he was inadequate, never held a good job, he was eliminated. This also was the procedure if the stigmata of chronic alcoholism were marked, such as tremors, flushed facies, memory defects, peripheral neuritis, etc. Acute alcoholics were kept in the ward for a few days, given salts, thiamine, and sedatives. Only after this was an estimate made of the subject's ability to withstand naval routine.

Twenty-nine subjects were discharged from the Navy with the diagnosis of psychoneurosis of one type or another, as indicated in table 2. This is 11.3 percent of the group surveyed. It was in this group that the greatest problems arose. Many men coming from civilian life had considerable difficulty adjusting themselves to Navy regime. Numerous psychoneurotic symptoms would appear which would be transitory and purely situational. These would disappear after the men had an opportunity to adjust themselves to their new way of life. It was the practice of the N-P board never to survey a man with the diagnosis of psychoneurosis until all organic possibilities were ruled out and the subject was followed at least two or three weeks while attempting to do full Navy routine. Many men were kept in the Navy with mild psychoneurotic symptoms and they undoubtedly will make excellent sailors. The history in these cases is a very important factor and was gone into with great care. The type of work done in civilian life, the amount of work missed because of their psychoneurosis, the frequency with which they had to visit their physician were important factors in determining whether or not a case should be surveyed. It will be noted that more than half the cases were discharged because of hysteria. In these cases all necessary consultations were had and reported as normal. All relevant laboratory work was done and reported as normal. Treatment in these cases consisted of psychotherapy, suggestion, physiotherapy, etc., and then if their hysterical complaints did not clear up they were considered for discharge.

The constitutional psychopathic states comprised 21 cases, or 8.2 percent, of the cases eliminated. This group contained the more obvious misfits. They just could not fit themselves into the routine of the

Navy. They would not take orders, would be A. O. L. or A. W. O. L. without apparent cause, they would have temper tantrums, emotional instability, and numerous trips to the brig and before the captain at mast. Here again the history was important. These individuals were found to be the same misfits in civilian life as in the Navy. They were unable to keep a job, were vagrant, were arrested frequently, never made much money, and on the whole were totally inadequate from the start.

Ten subjects were sent home because of somnambulism (3.9 percent). We are compelled to eliminate somnambulists for obvious reasons, and several excellent men were lost to the Navy because of this condition. Here again the men must have been seen walking in their sleep by someone in camp. No case was discharged on the history alone.

Migraine caused the dismissal of ten men from the Navy. The headaches had to be incapacitating and associated with gastro-intestinal or visual symptoms or both. In several cases a therapeutic test was given with gynergen with spectacular results. In every case that this substance was tried the headache was definitely relieved. The gynergen was given subcutaneously and in most cases caused a mild gastro-intestinal upset and a feeling of light-headedness. Despite these untoward symptoms the subjects were most grateful for the relief given.

The two chief reasons for sending patients to the hospital for discharge were that they were too ill to get home by themselves or that they had had previous service in the Navy or Marine Corps. A few cases were sent to the hospital for dismissal when the diagnosis was obscure, and further observation and laboratory tests were indicated. Our follow-up consisted of calling the hospital weekly. In almost all cases the discharge diagnosis was obtained (table 3).

TABLE 3.—*Cases sent to hospital for discharge*

Alcoholism, chronic.....	4
Amnesia.....	1
Congenital deformity.....	2
Constitutional psychopathic states:	
Emotional instability.....	1
Inadequate personality.....	2
Sexual psychopathy.....	1
Dementia paralytica.....	4
Dementia praecox.....	14
Disseminated sclerosis.....	2
Epilepsy: Grand mal.....	4
Fibroma, multiple.....	1
Intraspinal injury.....	1
Manic depressive psychosis.....	8
Migraine.....	1
Neuritis:	
Musculospiral.....	1
Sciatic.....	2

Paranoid state.....	1
Post concussion syndrome.....	1
Psychoneurosis:	
Anxiety neurosis.....	4
Compulsion neurosis.....	2
Reactive depression.....	2
Spinal-cord tumor.....	1
Spinal-cord disease.....	1
Unclassified.....	11
Total.....	72

Twenty-six of the seventy-two patients referred to the hospital were sent because of psychosis. Fourteen had schizophrenia, eight manic depressive psychosis, and four dementia paralytica. This comprises 36.1 percent of all the cases sent to the hospital for discharge. For obvious reasons all the psychoses were so transferred.

Eleven cases were sent to the hospital for discharge because of diseases which were unclassified in this clinic. This was 16.6 percent of the total number of patients sent to the hospital for elimination. This group consisted of some psychoses, vague neurological disturbances, and severe psychoneuroses.

Four cases of chronic alcoholism were sent to the hospital. They were sent because of previous naval service or because they were too disturbing to keep in our ward, where facilities to handle such cases were entirely inadequate.

Three hundred and forty-nine cases were seen by the N-P board but were returned to duty. Table 4 gives the distribution of these cases. Eighty-seven of this group were not neuropsychiatric problems and were sent to other departments for diagnosis and disposal. Sixty-four were considered to be mild psychoneuroses and were returned as fit for duty. Most of these cases were seen only once and apparently adjusted themselves to naval life shortly after we saw them. Many were followed for several weeks, and with mild psychotherapy and assurance were able to go back to their work and adjust satisfactorily. Fifty-three cases were returned to duty with "no disease." Headache was a very frequent complaint (23 cases). All organic causes for these headaches were ruled out either by an eye, ear, nose, and throat consultation, or x-ray, refraction, etc. The history and type of headaches were not suggestive of migraine nor were the headaches incapacitating. This group was classified as cephalalgia and in most instances relief was obtained by mild analgesics. Twenty-one cases of peripheral neuritis were sent back to duty as the disability was not incapacitating. Most cases were relieved by high-vitamin therapy and physiotherapy. Several cases of meralgia paresthetica were included in this group and responded fairly well to treatment.

TABLE 4.—*Cases seen and sent to duty*

Alcoholism.....	15
Borderline intelligence.....	15
Cephalalgia.....	23
Dementia pugilistica (mild).....	1
Habit spasm.....	1
Heat prostration.....	4
Herpes zoster.....	2
Inadequate personality.....	11
Malingering.....	5
Meniere's syndrome.....	1
Migraine.....	7
Myositis.....	4
Nightmares.....	1
No disease.....	53
Not neuropsychiatric.....	87
Nostalgia.....	10
Old spine injury.....	2
Paranoid personality.....	1
Peripheral neuritis.....	21
Post concussion syndrome (mild).....	8
Psychoneurosis (mild).....	64
Sciatica.....	3
Stammering.....	2
Total.....	341

SUMMARY AND CONCLUSIONS

In the first 6 months of the clinic's operation, 668 cases were referred for examination. Of this number 341 were returned to duty or referred to other departments. Two hundred fifty-five were given special order discharges and 72 were transferred to the naval hospital for elimination.

Almost 50 percent of the cases seen (327) were discharged either directly or by transfer to the hospital. Since we have heard that most recruit induction stations have been discharging 4 to 6 percent of the men coming through for neuropsychiatric disturbances, our average of approximately 0.75 percent appears quite low. We feel that this is due to the fact that, for the most part, our recruits are more mature, they are hand-picked, and the majority highly specialized artisans rather than a pure random sampling. Undoubtedly some undesirables have slipped by, but we feel that if they were not discovered during the 2-months' training period, which is of a severe type, it is improbable that these individuals will present any serious problems in the field.

While this method of weeding out undesirables was applicable with the type of group with which we had to deal, we do not advocate the discontinuance of the usual neuropsychiatric interview on the induction line, as we feel that it has a most important function to perform.

CLINICAL NOTES

PENETRATION OF HEAD BY LINE-CARRYING SPIKE¹

JAMES F. HAYS
Captain (MC) U. S. N.

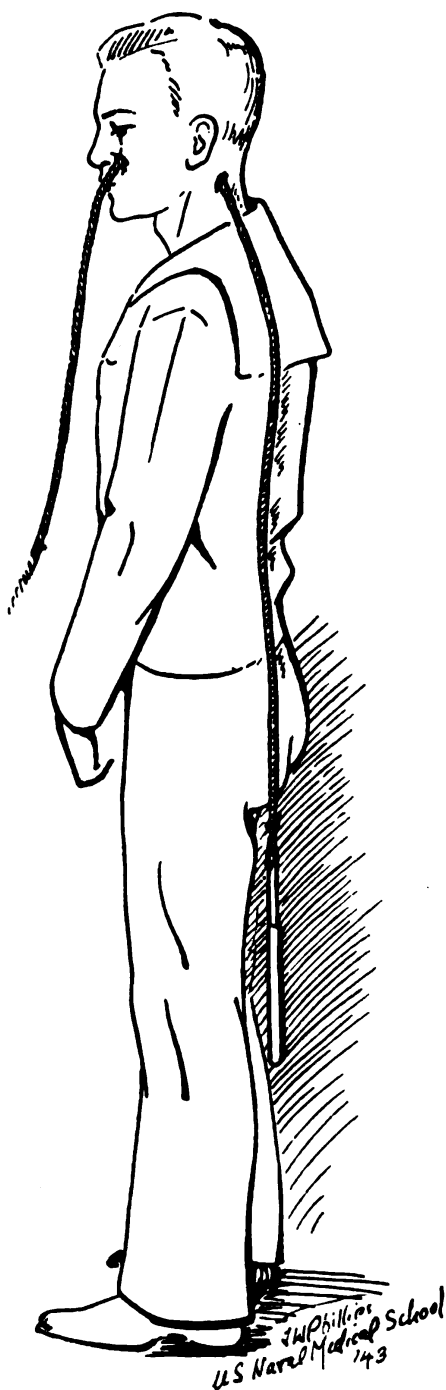
The morning of February 22, 1942, this ship was going alongside of a tanker preparatory to fueling. A line-throwing spike, carrying a light line, was fired by gun from the tanker, this to be used to haul a heavier line aboard. The proper way of firing this spike is to shoot it at an angle into the air so that the spike will clear the ship and the line which it carries will fall across the deck. Due either to the rolling of the ship or to the gunner losing his balance, the line-throwing spike was shot directly across the quarterdeck. At that moment a member of the crew had just come from below and had turned from the hatch toward the starboard side, when he was struck in the face by the spike. He called to others about him that he was hurt. I was immediately summoned and was with him within a minute. There was a line through the head, entering the left side of his face and leaving his neck in the left occipital region. On the end of this posteriorly was a spike which hung at the level of the left gastrocnemius muscle. The spike was 11 inches long, $\frac{7}{16}$ inches in diameter for $\frac{2}{3}$ of its length, then tapered off to $\frac{5}{16}$ of an inch in diameter on the after $\frac{1}{3}$. There was an eye on one end for attaching a line, the other end being rounded and blunt. The weight was half a pound.

The spike entered the head at the point where the ala of the nose joins the left cheek and had emerged at the hairline of the left neck $2\frac{1}{2}$ inches posterior to the angle of the left mandible. He was bleeding profusely from both wounds and from the mouth. The line was cut as near the nose as possible and carefully pulled through the head. He was immediately taken to the operating room, where he was treated for shock and the hemorrhage controlled while being made ready for operation.

Examination showed a $\frac{1}{2}$ -inch entrance wound, jagged and dirty, contaminated with heavy oil or graphite. The wound of exit was

¹ Received for publication June 12, 1942.

clean-cut, and not nearly as dirty as the entrance wound. Although it was painful for him to open his mouth, it could be seen that the



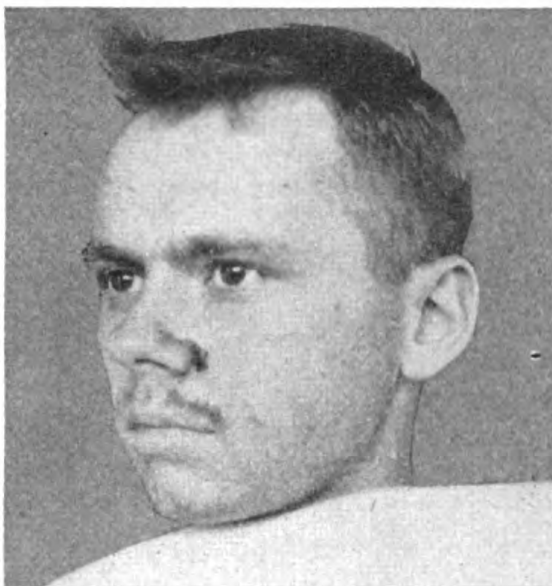
1. SHOWING APPEARANCE OF PATIENT WHEN FIRST SEEN

spike had penetrated the oral or pharyngeal cavity. There was a 1-inch jagged rent in the mucous membrane on the left side of the mouth, at the level of the upper first and second molars at the junction of the mucous membrane of the cheek and gum. A small amount of blood was oozing from this. The wounds were dried as much as possible and the edges thoroughly excised, great care being taken that no dirty tissue was left. Following excision and after two small arteries were tied off, sulfanilamide powder was copiously applied to all wounds, letting it go as deeply into each wound as possible without using pressure. All wounds were left wide open for drainage, without suturing. The spike had entered at the junction of the ala of the nose with the cheek on the left side, passed under the zygoma, through maxilla and antrum, under the masseter muscle, penetrated the buccinator, continued under the auditory canal, behind the angle of the mandible, missed the styloid process of the mastoid and the mastoid bone itself by a very small margin, and emerged from the neck near the hairline, $2\frac{1}{2}$ inches posterior to the angle of the left mandible. Many important structures lay in its path but since the head of the spike was rounded and blunt it evidently pushed aside these structures on its way through.

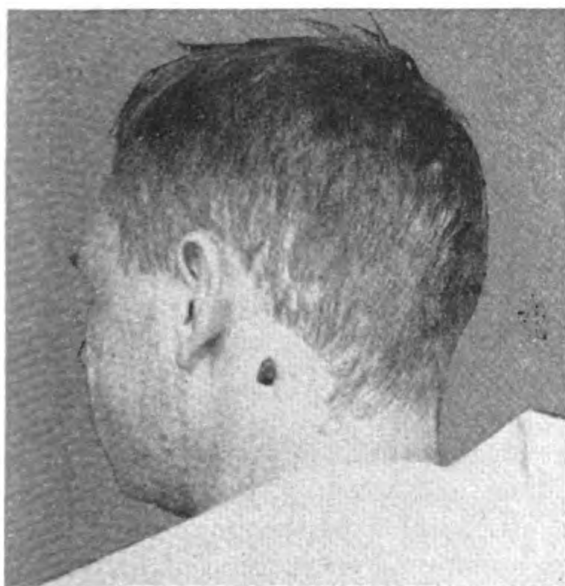
The patient's condition was good after the operative procedure was finished. He was given 1 cc. of tetanus toxoid and 1,500 units of

tetanus antitoxin. He had been immunized 2 months before with tetanus toxoid. Sulfanilamide was started orally, the initial dose being 4 gm., followed every 4 hours by 1 gm. day and night. A warm saline mouth wash was given several times daily. Liquid diet was necessary for the first few days as it was quite difficult for him to open his mouth or to swallow. Later in the evening of the first day there was considerable bleeding from the wound in the neck. Examination revealed a small artery had been missed deep in the wound posteriorly and this was tied off after considerable difficulty.

For several days afterward all wounds drained moderately and with no signs of infection. An x-ray was taken with our small dental machine but it proved of no help. On February 28, 7 days after



2. WOUND OF ENTRANCE.



3. WOUND OF EXIT.

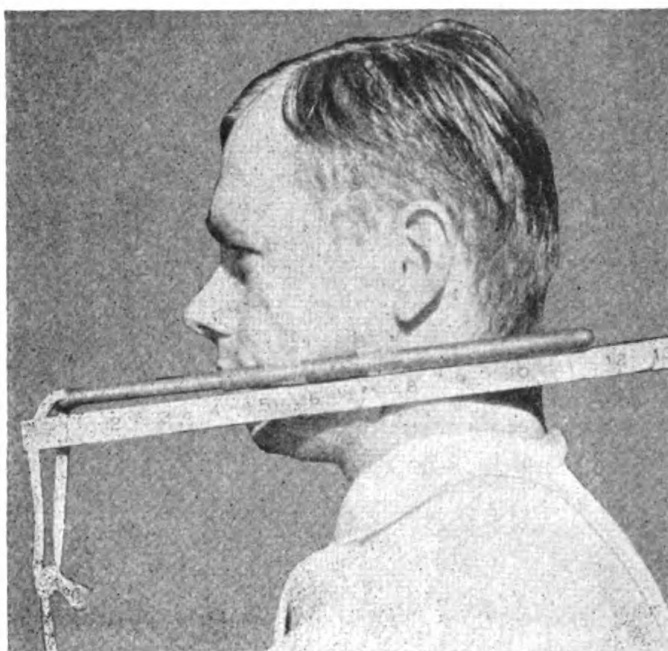
the injury, increasing cyanosis was noted with gradual temperature rise. The blood count was not remarkable and the urine was negative. The sulfanilamide was discontinued and these symptoms cleared. Fluids were forced, his diet increased and vitamin therapy instituted. He was kept in bed for a period of 13 days and carefully watched for evidence of thrombosis. After 13 days there were large firm scabs over the wounds of entrance and exit as shown in figures 2 and 3.

The rent in the mucous membrane in the mouth had stopped draining, and was closed. His only complaint was a slight occasional headache and the inability to open his mouth fully. On returning to

port he was taken as an ambulatory patient to the hospital ship, where an x-ray was taken. The report is as follows:

X-ray examination of the skull and facial bones reveals a perforating fracture of the lower portion of the left maxilla through the inferior angle of the antrum; there are several small comminuted fragments in this area and the left maxillary sinus is moderately cloudy, probably due to the result of contained hemorrhage at the time of injury. There are linear lines extending antero-posteriorly involving the maxilla, but no appreciable displacement or disturbance of normal position is evident. The root tip of the incompletely erupted upper left molar appears to be fractured. No other abnormality is

observed. Impression: Perforating fracture of the left maxilla through the antrum with some comminution.



4. SHOWING SPIKE AND ATTACHED LINE.

On the following day, 23 days after the accident the patient was transferred to a United States naval hospital for further observation and treatment, as the movements of this ship were not known.

During his 30-day stay in the hospital x-ray studies revealed practically the same findings as

above quoted. His only complaints were an occasional headache and difficulty in opening his mouth. He was able to open only $\frac{1}{2}$ inch. He was advised and encouraged to take mouth-opening exercises to stretch the fibers of the injured buccinator. This proved successful, and at this time he is able to open fully. He is now performing his duties as a baker with no complaints.

This case is remarkable in that for the type of injury sustained there was not more serious damage done, and secondly, that no infection occurred. This latter may be attributable to the immediacy with which the patient was seen, the promptness in excision of nonviable tissue and in removal of foreign matter, and the efficacy of the sulfonamides.

ISLET CELL ADENOMA OF THE PANCREAS ASSOCIATED WITH BILATERAL URINARY CALCULI¹

PAUL E. SPANGLER
Commander (MC) U. S. N. R.

Islet cell adenoma of the pancreas is one of the more recently recognized pathological conditions. The clinical syndrome of hypoglycemia and hyperinsulinism resulting therefrom is a still more recently described entity. The association of urinary calculus with this condition, I believe, is entirely coincidental, and I have found no casual relationship between the two conditions described in the literature.

Adenoma of the pancreas was first described pathologically by Nicholl's (1) in 1902. In 1926 Warren (2), of Boston, reviewed 20 cases but failed to attach clinical significance to these tumors. The discovery of insulin by Banting and Best (3) in 1922 stimulated great interest in the pancreas. The symptoms of acute hypoglycemia resulting from too much insulin were soon dramatically demonstrated in the course of therapy with this new discovery. Harris (4) in 1923 suggested the possibility of spontaneous hyperinsulinism and in 1924 presented 3 cases with low blood sugar which were improved by dietary means. Wilder (5) in 1927 reported a case of islet cell carcinoma with symptoms of hyperinsulinism. Exploratory operation revealed metastases to the liver, mesentery, and regional nodes. Finney (6) in 1928 explored a case of hyperinsulinism, and finding no tumor, resected a portion of the pancreas without relief. Howland (7) in 1929 reported the first surgical cure of hyperinsulinism, operated upon by Roscoe Graham, who excised an islet cell adenoma. Interest and information has gradually increased in this relatively rare condition. Whipple and Frantz (8) in 1935 collected 21 cases, including 8 of their own, of hypoglycemia in which islet cell tumors were found at operation. They collected reports of 10 others which were found at autopsy. Meyer (9) in 1941 was able to gather only 71 cases from the literature in which the diagnosis was made preoperatively and confirmed at operation.

The clinical syndrome associated with islet cell tumor of the pancreas has been called hyperinsulinism and hypoglycemia. The symptoms appear as the result of low blood sugar. They appear after periods of relative fasting or excessive work. They are relieved by the administration of carbohydrates. These tumors produce excessive amounts of insulin which is poured into the blood stream, thereby using up the available glucose with abnormal rapidity. When blood

¹ Received for publication December 21, 1942.

sugar falls below critical levels, symptoms appear. These may be only mild symptoms, as weakness, fatigue, vague abdominal distress, giddiness, etc., or they simulate almost any neurological or neuropsychiatric condition. The brain is particularly dependent on adequate blood sugar levels, and the low levels characteristic of this condition are capable of producing the most protean neurological manifestations. The history of "spells" with loss of memory is common. Diplopia is frequent. We may see more severe manifestations as coma, convulsions, epilepsy, hemiplegia, and etc. Usually these conditions clear up with proper treatment, though permanent damage may result from repeated insults.

The diagnosis is suggested by the history of difficulties developing when a patient is too long without food, or following vigorous exercise, which difficulties are relieved by the ingestion of food. The presence of hypoglycemia is then proved by low blood sugars and characteristic glucose tolerance curves. The blood sugar is usually 40 mg. or below when symptoms are present. The glucose tolerance test may be a fairly normal, or even a diabetic, curve, when carried out for only 3 or 4 hours. Harris (10) emphasized the fact that "the glucose tolerance test should be carried out for 6 full hours in making the diagnosis of hyperinsulinism." When this is done the low fasting blood sugar and the low terminal blood sugar level is characteristic. Conn (11) states "depression of the post-absorptive blood sugar value (taken before breakfast) below 50 mg. per hundred cubic centimeters means organic hypoglycemia with but few exceptions."

The extra pancreatic causes of organic hypoglycemia to be ruled out, according to Harris (10) are: (a) Deficient glycogenesis in the liver as from hepatitis, or massive tumors; (b) inadequate mobilization of glycogen due to deficient secretion by the adrenals; (c) pituitary dysfunction; and (d) thyroid dysfunction. When these causes of hypoglycemia are ruled out one is justified in concluding that the trouble is in the pancreas and the most likely cause is islet cell tumor of the pancreas. Diffuse hyperplasia of the islet cell tissue is less frequent.

The milder cases can be controlled by diet, the principles of treatment being frequent feedings of low carbohydrate, high fat diet. By giving a diet which delivers glucose to the blood stream slowly and over a longer period of time, stimulation of the islet cell tissue is avoided and a more continuous supply of sugar is furnished. Medical management does not cure. More serious cases, or those which cannot follow their diet, require surgical interference. Repeated shocks must be prevented. Conn summarizes the indications for surgical intervention as follows: (a) Absence of extrapancreatic causes of hypoglycemia, (b) abnormally low blood sugar during symptoms and rapid

relief of symptoms by the administration of dextrose, (c) repeated fasting blood sugar values below 50 mg. when patient has been eating an adequate diet, (d) depression of fasting blood sugar values below 40 mg. by carbohydrate restriction.

Discovery and removal of an islet cell tumor will result in a high percentage of cures. Malignant degeneration, which is not uncommon, may preclude the possibility of removal. Of 71 cases collected by Meyer, 37 percent were classified as malignant. If no tumor is found, subtotal pancreatectomy will result in around 50 percent of cures or improvement.

Whipple and Frantz in 1935 laid down rules for the surgical approach which are time-tested. These are: (1) Spinal pontocaine is the anesthetic of choice. Complete relaxation is essential. (2) A wide transverse incision, including both rectus muscles, provides the best approach. (3) A wide division of the gastrocolic omentum exposes the entire pancreas to inspection. (4) The adenoma appears as a purplish-pink nodule 1 to 2 centimeters in diameter, usually encapsulated and shells out easily. (5) If one adenoma is discovered, search should be made for others. If none are found the pancreas should be mobilized by incising its inferior peritoneal attachment and gently elevated, inspected, and palpated on its posterior aspect. Lastly, the head of the pancreas should be palpated by freeing the right border of the duodenum and then palpating the head between the fingers. Bleeding is most apt to be troublesome about the head. (6) The tumors are most frequently found in the body and tail and should be looked for in these areas first. (7) If no tumors are found, the next most effective measure is the removal of at least two-thirds of the pancreas, i. e., the tail and body, leaving the portion of the head in the curve of the duodenum. (8) A drain should be placed down to the bed of the pancreas if the organ is resected. The site of an enucleated adenoma may not require drainage. (9) They advocate silk technic throughout.

The case here presented is interesting in that the disease was discovered following severe neurological manifestations which occurred during convalescence from a common urological condition.

CASE REPORT

N. L. W., age 26 years, was admitted to Mobile Hospital No. 2 on July 7, 1942. His chief complaint was severe colicky pain in the left flank, of 2 days' duration. Twelve days prior to admission the patient believes he passed some gravel through the urethra. Nine days prior to entry he had gross hematuria. The remainder of the history was negative.

On admission his general physical examination was negative except for tenderness in the region of the left kidney and moderate muscle spasm in the left flank. Urological examination revealed 4-plus albumin, no sugar, many red and white blood cells. Flat K. U. B. plates indicated a right renal pelvic calculus,

and left upper ureteral calculus. Retrograde pyelograms revealed "the left ureteral catheter adjacent to the calculus in the left ureter and no dye passes beyond the stone. The ureter below the calculus is normal. The right ureteral catheter reaches the uretero-pelvic junction, and the dye outlined the entire renal sinus and ureter with no abnormality in their contour except for widening of the infundibulum to the superior calyx. The large calculus lies within the pelvis of the right kidney." I. V. pyelograms resulted in good visualization of the right kidney, while the left kidney failed to secrete sufficient dye for visualization. The diagnosis of left ureteral calculus with partial blockage, and of right renal calculus with good kidney function, was established.

Six days after admission, the patient underwent operation for the left ureteral calculus. The operation was performed under spinal anesthesia, using 150 mg. of novocaine dissolved in spinal fluid. The operation lasted 45 minutes and was without incident. The kidney was found slightly enlarged. The calculus was impacted in the ureter opposite the lower pole of the kidney. The ureter was dilated above the stone. Urine was recovered under pressure. The ureter was isolated and incised over the calculus. The calculus was removed. Ureter was closed. Kidney was not mobilized. A rubber drain was inserted.

The first few hours after the operation were uneventful. The patient reacted well. The first night after the operation he seemed to be confused at times, and then he would be clear and rational for a period. He took fluids well, and his urinary output was adequate. Periods of confusion, with bed wetting, attempts to get out of bed, irrational talk, etc., continued. On the second day after the operation he was seen by the neurologist, who concluded he was suffering from a "mild toxic delirium." Fluids were advised, with discontinuance of other medication as far as possible. These measures included an intravenous of 1,000 cc. of 5 percent dextrose in saline, after which a slight temporary improvement was noticed.

Four days after operation the patient took a turn for the worse. He was comatose and developed a right hemiplegia. Neurological consultation concluded that "the findings point to a disturbance in the left cerebral hemisphere involving the pyramidal pathways. In the absence of pressure and neurological findings, embolism or thrombosis of the middle cerebral, or one of its branches, requires consideration." A medical consultant confirmed this diagnosis. It was concluded that "the patient's condition indicated a cerebral thrombosis; however a false uremia possibly resulting from cerebral edema as end result of his bilateral kidney impairment is the more likely diagnosis."

The patient's condition became rapidly critical. His pulse became weak and his respirations stertorous. He appeared in extremis. Caffeine sodio-benzoate was given without improvement. As a rather forlorn hope an intravenous of 1,000 cc. 5 percent dextrose in saline was instituted. During the administration he regained consciousness and his condition began to improve. Shortly after the completion of the infusion, he was able to take some orange juice. He remained rational all that night and did fairly well on his fluids by mouth. Blood sugar taken in the morning was 72 mg. With this rather dramatic improvement, dextrose therapy was continued. He was given 3,000 cc. of 5 percent dextrose in normal saline daily. During the next few days the patient continued to improve. His actions were a bit queer. He would frequently refuse nourishment by mouth for no very clear reason. Bed wetting was frequent even though he was entirely rational.

Seven days after his operation, and 4 days after his hemiplegia developed, the neurologist reported: "The hemiplegia has largely disappeared. Slight weak-

ness of the right lower face persists. Deep and superficial reflexes active and equal. Fundi normal. Considerable mental confusion with a mixed aphasia. Perseveration occurred frequently."

Hypoglycemia was suggested as a possible causative factor at this time, but it was thought unlikely to be of prime importance. The patient continued to improve. He gradually regained his appetite and was soon taking a normal diet. He was out of bed and around the ward 2 weeks after operation; the wound was well healed.

A week later he began having trouble with constipation. Enemas gave only fair relief. Coincident with this there was a noticeable loss of appetite. Several days later the patient became comatose. There was a recurrence of his right hemiplegia. An immediate blood sugar was done and found to be 32 mg. Forty cc. of 50 percent dextrose was administered intravenously. Improvement was remarkable. In 15 minutes the patient was conscious and was asking, "Did I pass out?" In 40 minutes the facial paralysis was gone. Under continued dextrose therapy, both by vein and by mouth, his condition continued to improve, and in a couple of days he seemed none the worse for his recent experience.

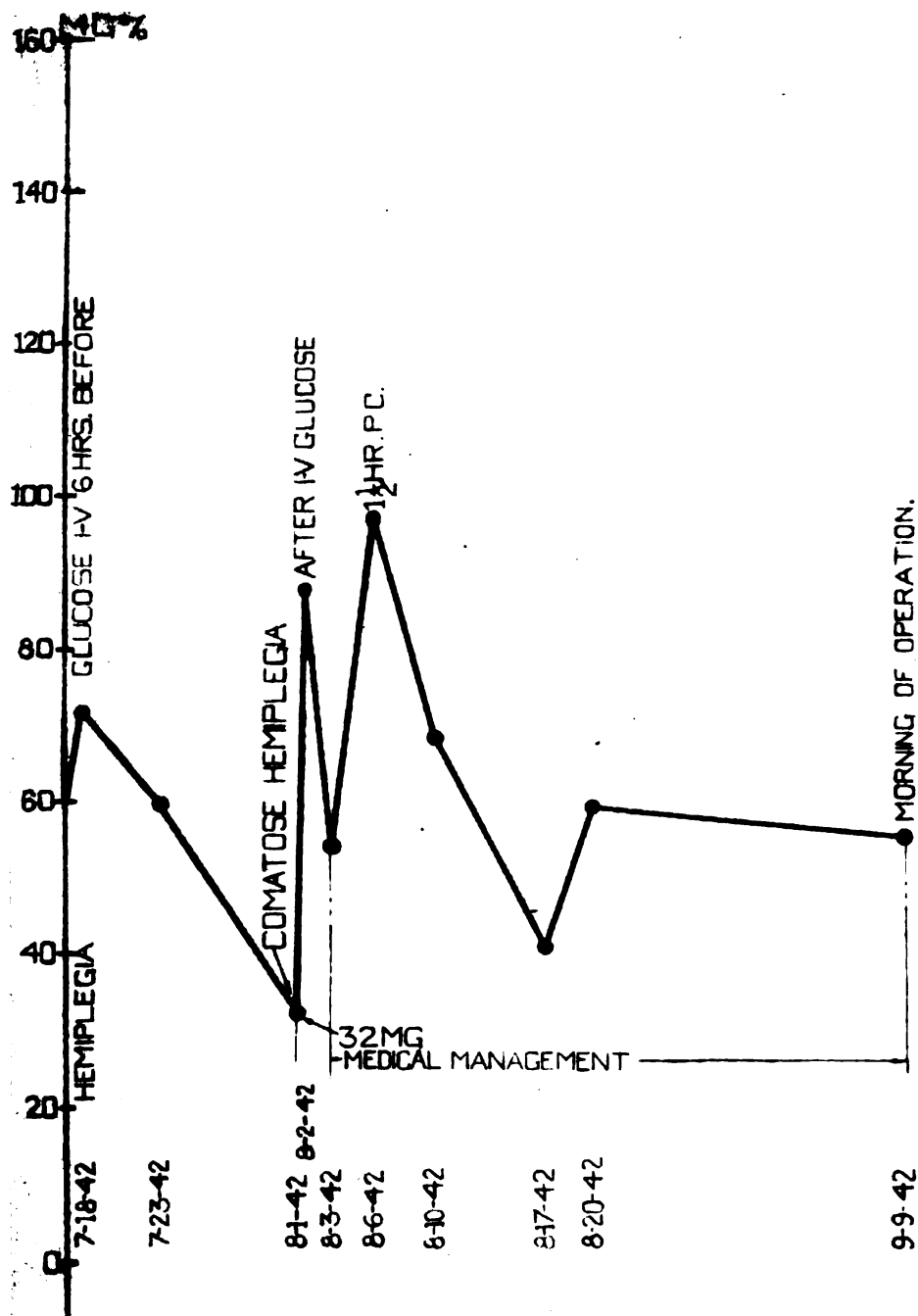
After this demonstration of the profound effect of dextrose therapy, together with the extremely low blood sugar, we felt justified in considering this a case of hypoglycemia, very possibly on the basis of an islet cell tumor of the pancreas. Therefore further work-up was indicated, and the patient was transferred to the medical service.

Here nothing additional was elicited except that the patient recalled that 4 years previously he would experience double vision when he failed to get back for his noon meal on time. This had been relieved immediately by ingestion of food. After considerable study on this service it was felt that extrapancreatic causes of hypoglycemia could be eliminated, justifying a diagnosis of hyperinsulism. The fasting blood sugar continued low. The variations are shown in figure 1. The glucose tolerance curve (fig. 2) is fairly characteristic, 64 mg. to start with, rising to a peak of 160 mg. in 30 minutes, then gradually falling to 52 mg. at the end of 4 hours.

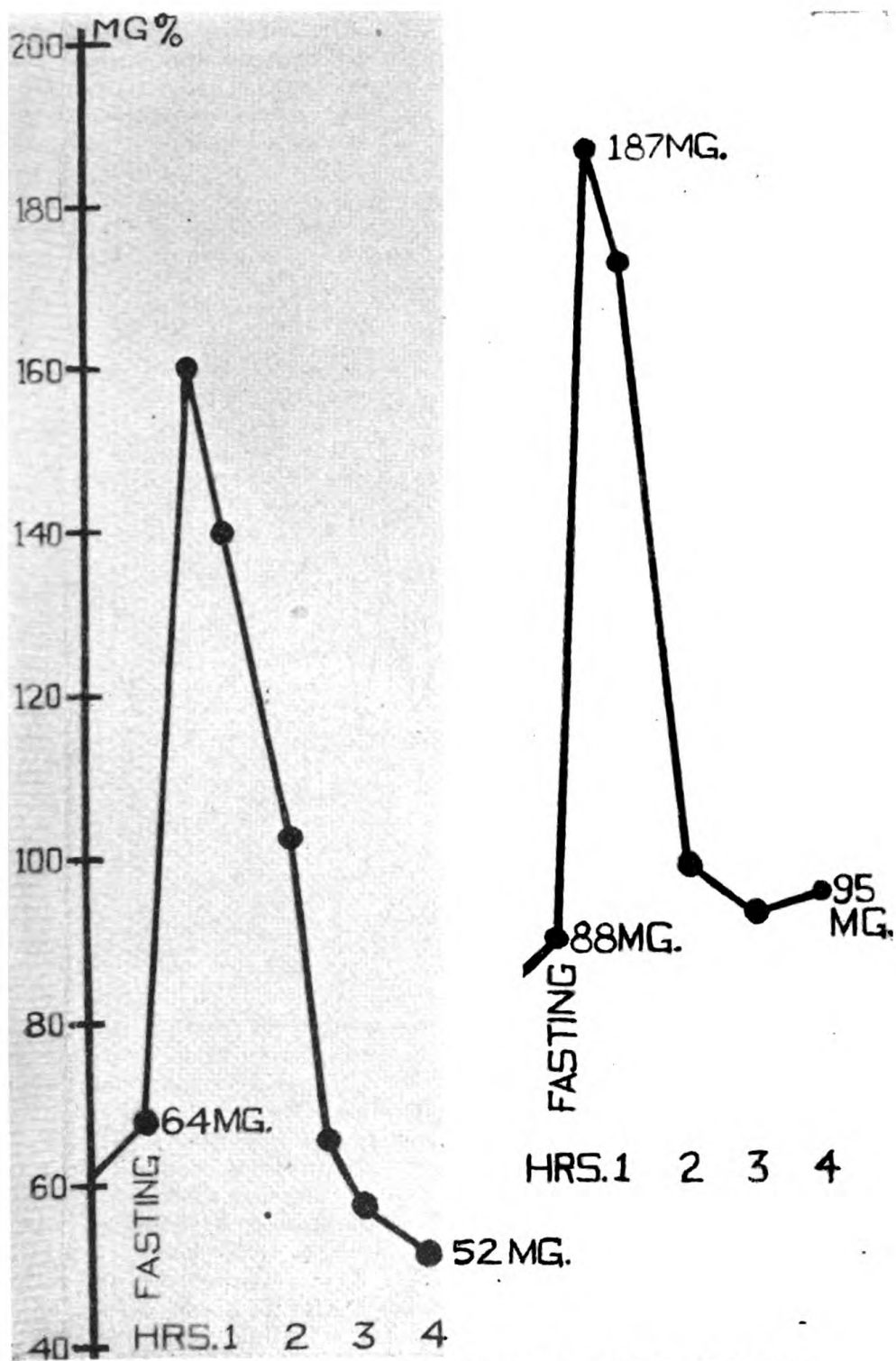
The patient was well controlled by medical management. Diet consisted of high fat, normal protein, and carbohydrate. Carbohydrates were largely furnished by 5 percent and 10 percent fruits and vegetables. He was put on feedings every 3 to 4 hours and allowed eating between meals as desired. He was entirely symptom free on this management, but periods of starvation were persistently followed by abnormally low blood sugars (fig. 1). His urinary condition gave him no trouble, though he continued to run a varying amount of albumin and white and red cells in his urine. The N.P.N. and creatinine tests remained normal. Recheck of intravenous pyelograms revealed good visualization of both kidneys, and they appeared normal except for the stone remaining in the right pelvis. It was felt this was the cause of the urinary findings.

At this stage, after over a month of medical study and management, it was felt that the patient should not be subjected to further operative procedure without first correcting the underlying metabolic disorder, which was believed to be due to an islet tumor of the pancreas. The patient was therefore transferred to the surgical service 8 weeks following his first operation. An exploration of the pancreas was done. The fasting blood sugar just before the operation was 55 mg. The patient received 1,000 cc. of 5 percent dextrose in saline intravenously immediately before the operation.

The operation was carried out under spinal anesthesia induced with 100 mg. of novocaine and 15 mg. of pontocaine dissolved in 3 cc. of spinal fluid. One-



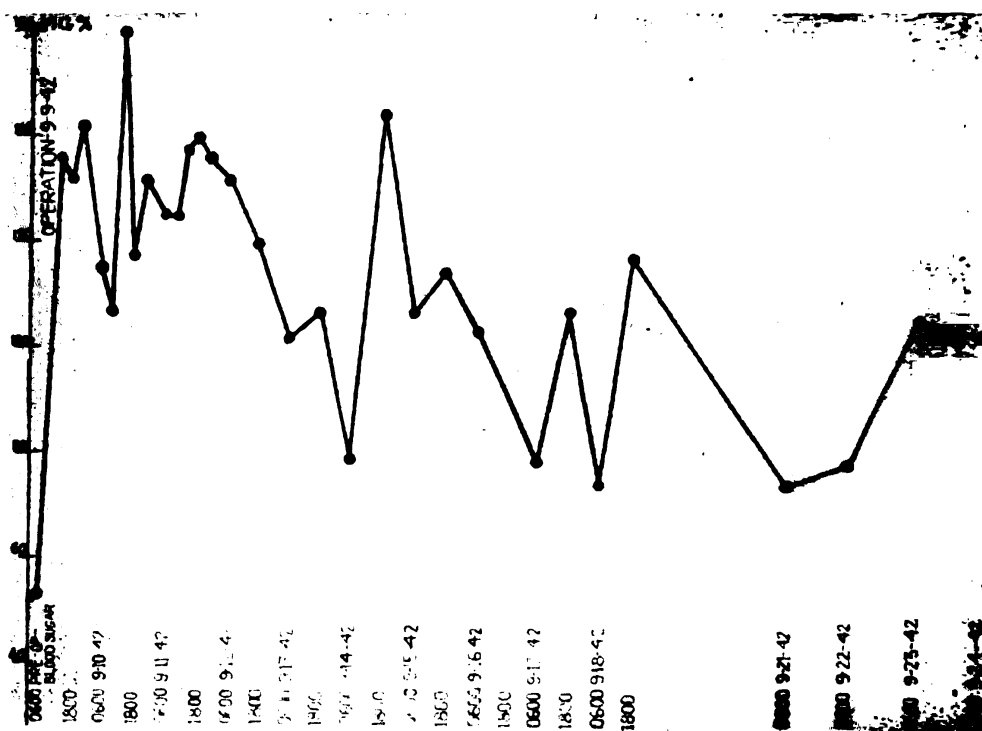
1. PREOPERATIVE BLOOD SUGAR.



2. GLUCOSE TOLERANCE CURVES PRE- AND POST-OPERATIVE.

half cc. of 1:1000 epinephrine was given after the spinal to support the blood pressure and to mobilize the glycogen.

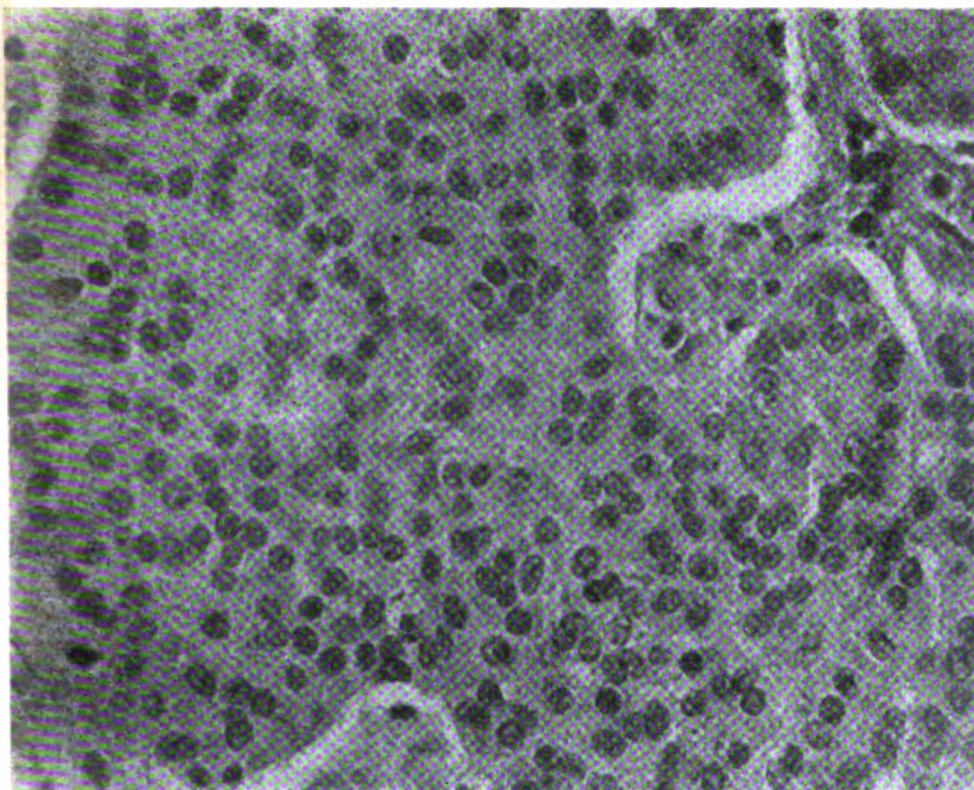
A wide transverse incision was made through both rectus muscles about 2 inches above the umbilicus. The general abdominal cavity was explored and found normal. No tumor could be palpated in the region of the pancreas. The gastrocolic omentum was next widely divided, nicely exposing the pancreas in the floor of the omental bursa. No tumors could be seen. Palpation of the head and body revealed no tumors. However, in the tail of the pancreas, on the posterior surface, lower border, three small adenomas were palpated. These were shelled out by blunt dissection through the pancreatic tissue. They were fairly well encapsulated and shelled out without great difficulty. There was



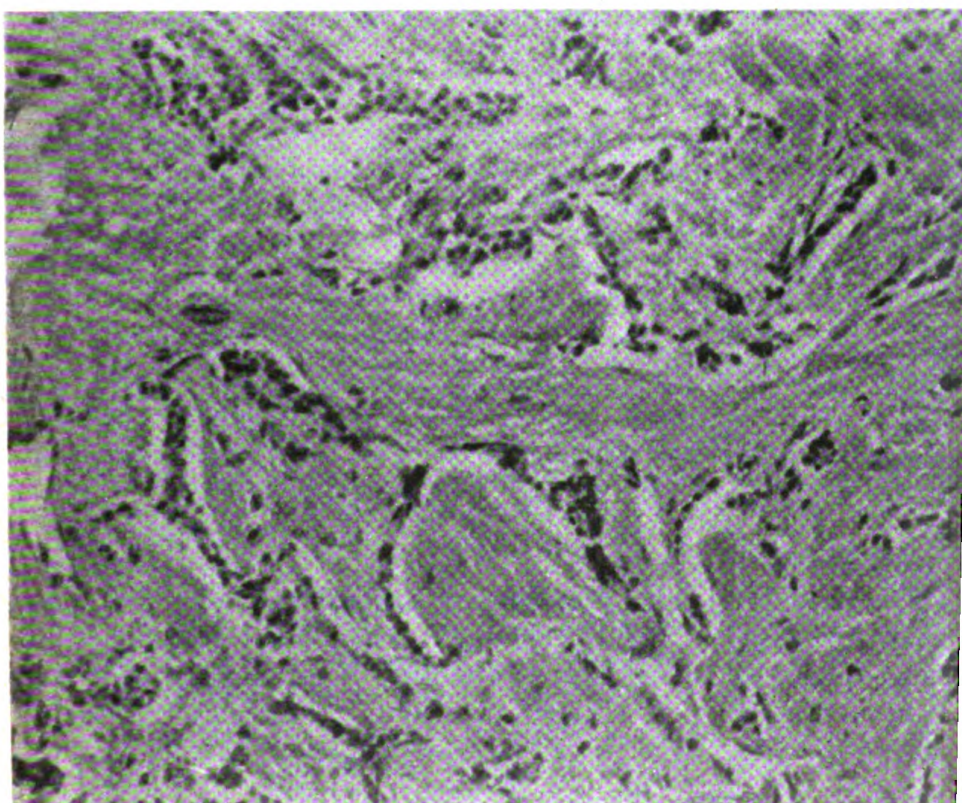
3. POSTOPERATIVE BLOOD SUGAR CURVE.

minimal bleeding. A rubber-tube drain was brought out from the site of the tumors through a stab wound. The defect in the gastrocolic ligament was closed. The wound was closed in layers with interrupted chromic catgut. The patient received 600 cc. of 5 percent dextrose in saline intravenously while on the operating table. He was returned to his room in good condition.

After the operation he received no further intravenous therapy. He was allowed to take liquids as desired, which he did in adequate amounts. Urinary output was maintained at satisfactory levels. Blood sugar determinations were made every 4 hours for the first few days, then two times daily, and finally once a day. The results are shown in figure 3. As was expected, the blood sugar was maintained at a good high level immediately after the operation in spite of low carbohydrate intake. After a few days his normal diet was resumed, and as the patient was recovering from the operation the curve tended to assume a lower level, which proved entirely adequate. The postoperative glucose tolerance curve (fig. 2) became within normal limits.



4. MICROPHOTOGRAPH (X 600) OF SECTION OF ACTIVE ADENOMA.



5. MICROPHOTOGRAPH (X 260) OF SECTION OF SCLEROSED ADENOMA.

Pathological report (figs. 4 and 5). "The first specimen removed consists entirely of adenomatous tissue surrounded by a thin capsule. The individual cells are remarkably uniform in appearance and occur in cordlike arrangement of varying sizes. In many instances these cords are separated from each other only by their basement membranes. In other instances such separation is effected by considerable connective tissue of a rather cellular and vascular character. Eosinophilic leukocytes are fairly numerous in this connective tissue.

"The individual tumor cells have very poorly defined cytoplasm, which is faintly eosinophilic when stained with hematoxylin-eosin, and finely granular in character. The nuclei are round to oval, quite vesicular, and contain a well-dispersed chromatin network. Nucleoli cannot be identified. In general, the nuclei show a distinct tendency to be located in the basilar portion of the cells, and there is no suggestion of an acinar arrangement of the cells. No mitotic figures or suggestions of intravascular extension of the tumor cells is noted. There is no suggestion of zymogen granules in the cytoplasm of the tumor cells. * * *

"The second specimen removed presents essentially the same microscopic appearance as the first, with more structural variations in the size of the cords of tumor cells and the amount of intervening connective tissue. * * *

"The soft portion of the third specimen removed consists of essentially normal appearing pancreatic parenchyma in which there is a marked congestion of the blood vessels and some recent extravasation of erythrocytes into the surrounding tissues. The portion which grossly resembled a fibroma is seen microscopically to consist of a well-encapsulated adenoma similar to the two previously described, except that it is subject to marked replacement by dense, relatively acellular, collagenous connective tissue. This sclerosing process is much more pronounced on the periphery of the nodule than centrally. On the periphery of this fibrosing nodule there is present some normal pancreatic tissue."

The diagnosis—Adenomata of islets of Langerhans—was returned by the pathologist.

The patient's convalescence proceeded nicely. The blood sugar remained normal (fig. 3). He lost his constant desire for food between meals. He developed a slight but persistent reflex regurgitation of food, usually liquids, for which no cause could be found. It was felt that it was reflex mechanism—perhaps on the basis of the presence of his right kidney stone. The urine continued to show irritation, and the x-ray showed the stone to be increased in size.

He was returned to the urological service, and a right pyelolithotomy was done, the large calculus being removed from the pelvis of the right kidney without difficulty. His convalescence from this operation proved uneventful. Three weeks after his last operation he was sent home on sick leave, completely relieved of all urinary and pancreatic signs and symptoms.

CONCLUSION

A case of bilateral urinary calculus complicated by islet cell tumors of the pancreas has been presented. The severe metabolic disturbance manifested itself by two attacks of hemiplegia during convalescence from the first kidney operation. These attacks were relieved by dextrose. The disturbance of the sugar metabolism was

corrected by removal of the adenomata from the pancreas. Finally the right kidney stone was removed, providing complete relief.

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ANKLE ARTHRODESIS IN TUBERCULOSIS

Arthrodesis is the treatment of choice for tuberculosis of the ankle and talocalcaneal joint regardless of age. This procedure very often gives an excellent clinical result, without evidence of disability.

In younger patients with extensive bone destruction or in poor general condition, a preliminary rest period of 4 to 6 months may be advisable.

The average period of disability when this form of treatment is used is much less than when a conservative regimen is followed.

Amputation is rarely if ever indicated in the treatment of tuberculosis of the ankle.—Houkom, S. S.: Tuberculosis of the ankle joint. *Surg., Gynec. & Obst.* 76: 438-443, April 1943.

DISSECTING ANEURYSM OF THE ENTIRE AORTA WITH PARTIAL BILATERAL RENAL ARTERY OCCLUSION ¹

REPORT OF A CASE

HARRY HALPRIN

Lieutenant Commander (MC) U. S. N. R.

The diagnosis of a dissecting aneurysm always presents a difficult task. The subject becomes more difficult when symptoms and clinical features of the case tend to be at variance with the true underlying structural pathology. A case is herewith presented which is unusual in its clinical symptomatology and rare in its sequelae and autopsy findings.

The clinical picture noted in this instance was one of malignant hypertension with a definite terminal uremia and death in uremic coma. The pathology found at autopsy of an almost complete constriction of the renal arteries by a dissecting aneurysm justified the diagnosis of uremia.

In spite of the fact that the pathological changes associated with dissecting aneurysm of the aorta are very marked and striking, the condition only rarely has been recognized during life. Failure to recognize the disease in this patient stimulated my interest in the subject.

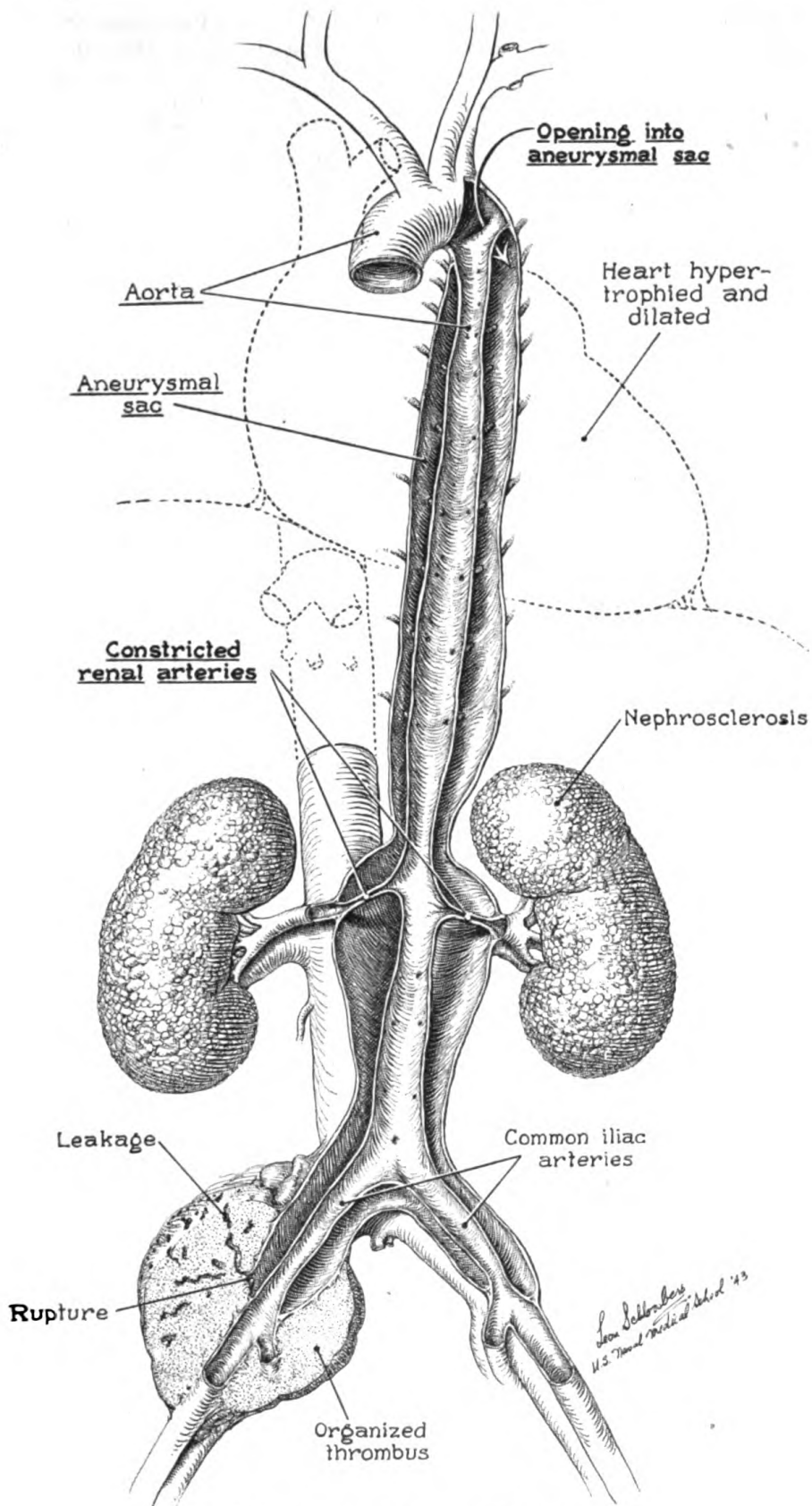
CASE REPORT

W. H. G. was admitted to the hospital in a confused mental state and was unable to give a clear history of his illness. He was dyspneic and complained of pain in chest. He was aware of having had hypertension for the past 5 years. However, it did not incapacitate him. Shortly before hospitalization he suffered severe pain in his chest. There was a large contusion in the right lower quadrant of his abdomen which the patient associated with a fall he had recently sustained.

He was a large-boned individual whose physical findings were indefinite, but whose blood pressure remained rather constant around 220/130. He did not improve, however, became gradually weakened, sinking into a coma apparently of a uremic nature, expiring within 5 weeks after admission.

The autopsy findings revealed a smooth-edged, transverse rent in the intimal wall of the arch of the aorta, 1 cm. beyond the exit of the left subclavian artery (fig. 1). This rent communicated with a large dissecting aneurysmal cavity, extending down the entire length of the aorta, along its posterior aspect, through

¹ Received for publication March 4, 1943.



1. DISSECTING ARTERIAL ANEURYSM.

the bifurcation and into the iliac arteries. On the left, the aneurysmal cavity terminated blindly at the bifurcation of the hypogastric artery. On the right, the aneurysmal space spread downward beyond the bifurcation of the hypogastric artery, finally rupturing through the media and adventitia forming a large organizing thrombus in and surrounding the point of rupture. Extending from this point was an 8 to 15 cm.-wide, dark band, which lay within the wall, below the peritoneum and completely encircling the lower abdominal cavity.

This compression extended down beyond the ostia of the renal arteries, practically occluding them and embarrassing the renal circulation—factors which accounted for the antemortem symptomatology, confusing the clinical picture and leading to a mistaken primary diagnosis.

Most of the cases in literature occur in the age group of 40 to 60 years, chiefly in men having hypertension and arteriosclerosis. The onset of symptoms are either abrupt or follow closely upon an episode of emotional disturbance, exertion, or physical trauma.

At autopsy the usual findings are:

1. Generalized arteriosclerosis, particularly involving the aorta and vasa vasorum;
2. Left ventricular cardiac hypertrophy;
3. Arteriosclerotic nephritis; and
4. Aneurysm, which may involve a part or all of the aorta, extending even into its branches.

It is generally conceded that a true dissecting aneurysm does not occur in the normal aorta, even though violent external trauma is capable of causing a tear completely through the wall of the aorta. It is concluded that a preexisting lesion of the wall is requisite for the occurrence of a dissecting aneurysm.

Consensus is that the lesion is a degenerative process of the media involving principally the smooth muscle and elastic laminae producing cystic spaces and "faults." These abnormalities are distributed in patches or diffusely along the course of the vessel and found most marked in the region of the internal tear. The cause of the medial changes are not satisfactorily explained. It is acknowledged that the process is not of an inflammatory nature. Proliferation, thickening, and in some instances thrombosis of the vasa vasorum have been emphasized by some writers as the causative agent involved; others however have either denied or minimized the role of the vasa as a noteworthy predisposing factor.

Various toxic agents such as epinephrine, nicotine, the excessive accumulation of products of metabolism, and the toxins of bacteria likewise have been discussed as productive causes of the degenerative changes. Be the cause as it may, it is generally conceded that in true dissecting aneurysm of the aorta, the media is the site of degenerative changes. Marked loss of smooth muscle and elastic tissue, with the occurrence of mucoid filled cysts and "faults" were constant findings.

Absence of all signs of inflammation, in both the media and the overlying adventitia, were consistently observed, to suggest that in some instances the dissection begins as a rupture of the vasa with hemorrhage between the elastic laminae. The destructive changes of the muscular and elastic tissue closely resemble slowly progressing infarcts, such as are exemplified by the patchy fibrosis of the myocardium, so that interference with the blood supply of the wall of the aorta must be suspected.

The site of the intimal tear is most commonly just above the aortic valves on the posterior surface, and there may be one or more additional tears permitting recommunication with the aortic lumen. The dissection usually occurs between the middle and outer thirds of the media. Healing may take place with proliferation of the intima and the formation of a double aorta, but usually there is external perforation into the pericardium (193 out of 273, or 70 percent of the cases reported by Free), left pleural cavity, mediastinum, esophagus, bronchi, trachea, retroperitoneal tissues or abdominal cavity. Tyson has emphasized the importance of sclerotic changes in the vasa vasorum, resulting in medial degeneration. Rupture of one of the vasa vasorum occurs, followed by hematoma formation in the weakened media. Later there is perforation into the weakened lumen. Others have emphasized the importance of a weakened arteriosclerotic intima, with rupture due to trauma from without or from chronic or momentarily increased blood pressure. Although syphilis has been found in some cases it does not seem to be related to this type of aneurysm.

To say that there are classical signs and symptoms for the recognition of this phenomenon would be a misleading statement. The findings and subjective complaints depend more on the site and type of lesion rather than on the accident itself.

The usual onset is marked by:

1. Spontaneous, sudden, and persistent pain in the region of the site of rupture or beginning dissection. It may therefore be in the chest, back, lumbar region, or abdomen. The radiation of the pain is as varying as the site of the pain but it is severe and may be spasmodic or even rhythmic. It may not be relieved by large dosage of morphine. Also of importance is the fact that unless the rupture is accompanied by profuse internal hemorrhage and sudden death, there is no apparent extreme shock present. There is no marked acceleration of the pulse, the skin does not become cold and clammy, and a very important differential finding is the fact that there is no appreciable fall in the blood pressure. In this respect it is similar to abdominal apoplexy, but in the latter the pain is usually only abdominal. Recovery through organization of the clot or through formation of a double aorta by new intimal proliferation has occurred infrequently.

2. When the dissection is into the abdominal aorta, difficulty in swallowing, and associated vomiting without nausea (usually after the first morning meal) are symptoms not to be overlooked.

3. There is usually voluntary spasm present in the abdomen and some tenderness.

4. Moderate temperature, polymorphonuclear leukocytosis as high as 25,000, and albuminuria are common.

5. Sudden death is frequent, but prolongation of life for months is possible, dependent upon the amount of organization, dissection, and canalization of the aorta.

6. When one is confronted with the problem of the severe pain above described, in association with the physical findings enumerated, it becomes necessary to consider by way of differential diagnosis:

- (a) Coronary thrombosis.
- (b) Mesenteric thrombosis.
- (c) Abdominal apoplexy.
- (d) Pulmonary or peripheral emboli and thromboses.
- (e) Mediastinal abscess or neoplasm.
- (f) Acute abdominal conditions.

The bizarre and unexplainable complication of uremia in the present case only masked the true nature of the underlying pathology and confused the diagnosis.



SULFONAMIDE EFFECTS ON BLOOD PLASMA

There appears to be accumulating sufficient evidence to indicate that in occasional patients being treated with the sulfonamide compounds the blood platelets may be depressed to the extent of producing severe thrombopenic purpura.

Daily platelet estimations were carried out in 61 patients being treated with sulfathiazole, and the results indicate that there is a slight platelet depression on the first day of treatment and a rather decided increase of platelets on the first day after cessation of treatment.

The fact that the sulfonamide compounds appear to be capable of depressing platelets in an occasional person makes it all the more important that these drugs should be used with caution only under supervision of physicians and that hematologic studies should be done frequently to determine any untoward effects on the blood.—Kracke, R. R., and Townsend, E. W.: The effect of sulfonamide drugs on the blood platelets. *J. A. M. A.* 122: 168-173, May 15, 1943.

PERFORATING FOREIGN BODY OF CECUM

STEPHEN A. ZIEMAN

Lieutenant Commander (MC) U. S. N. R.

Acute abdominal conditions undoubtedly are major problems in the average surgical practice. Diagnosis and proper treatment basically depend upon the personal acuity, judgment, training, and experience of the surgeon. His impression of the clinical situation is the determining factor irrespective of the findings of such auxiliaries as laboratory, x-ray, history of the patient, and the like.

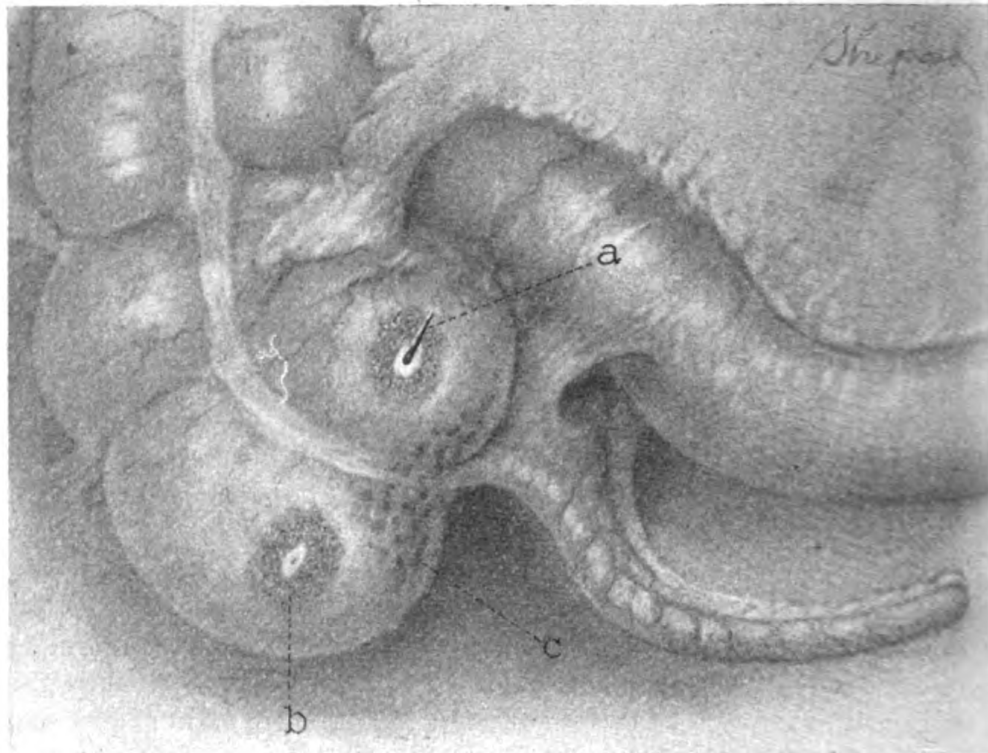
Courage begot of conviction insists upon a course of action founded upon principle and experience. To operate and find a normal appendix may invite the pathologist's cynical smile, not to operate and find abdominally at necropsy an appendiceal concretion is catastrophic and but one step removed. The present case is illustrative of just such a fact in hand.

The patient had an unimpressive history, yet clinically was decidedly ill. There was definite muscle rigidity over the entire lower quadrants of the abdomen with positive rebound tenderness referred to McBurney's area. The temperature was inconsequential, as were the blood and urinalysis. The facies and general circumstantial appearance suggested a seriously ill patient, definitely in pain. There was interpretable pathology in the lower right quadrant irrespective of the lack of confirming incidental findings. This patient, it was felt, was suffering from an acute fulminating appendicitis with probable recent rupture of the organ and concomitant peritonitis. Time only would substantiate the diagnosis. Operation consequently was decided upon and preparatory steps immediately undertaken.

Upon entering the peritoneal cavity serosanguineous fluid welled up into the field. The cecum was isolated and delivered, followed by an exceptionally long appendix vermiformis. The appendix was only slightly injected but the base of the cecum presented a mottling of petechial spots that portended further pathology. On releasing the gauze-protective hold upon the cecum a scarified ulcerated lesion (fig. 1) on the lateral aspect of the organ was discovered. It was thought that pinching of the bowel possibly produced the lesion and warranted further investigation. Rotating the colon laterally a black foreign body was seen perforating through the center of a similar ulcerated area. The object appeared to be a fishbone and was firmly adherent to the bowel, necessitating removal with a hemostat.

Both ulcerated areas were sprinkled with sulfathiazole crystals and purse-stringed over with an intestinal stitch. The appendix was removed and the abdomen closed in layers after spraying them with the sulfonamide.

Examination of the foreign body later revealed it to be a toothpick incrustated with fecal deposits.

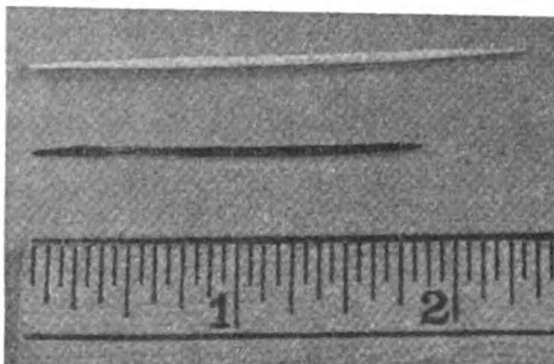


1. APPEARANCE AT OPERATION OF FOREIGN BODY (A) PERFORATING CECUM. (B) AREA OF ULCERATION WITH A CENTRAL PERFORATION. (C) PETECHIAL SPOTS.

Conjecture as to the possibility of a person swallowing unknowingly a full length toothpick brought out certain interesting comments.

First, the patient had been accustomed to eat "beef birds" which were rolled and pinned together with toothpicks. The long baking of such morsels may have softened the wood sufficiently to cause it to

lose its resistance. That one could swallow such an object (fig. 2) portrays the careless mastication habits of the individual. However, considering the loss of touch sensation that can occur in a patient with upper and lower dentures, it is not only possible but explanatory as in the present instance.



2. FULL-LENGTH TOOTHPICK COMPARED WITH THAT RECOVERED FROM CECUM.

At one time or other everyone has had the experience of accidentally swallowing a foreign body. The realization of suddenly becoming the repository of such an article startles the composure of even the most self-controlled.

The literature is replete with every imaginable object from tin whistle, coin, fishbone, to nails, pins, bobbies, and tacks. Some will require the ingenuity of a Chevalier Jackson to dislodge, others will travel the circuitous alimentary course in nature's own way, while still others will demand immediate surgical intervention for recovery.

Toothpicks as causative agents have been reported on only one other occasion as indicated by the available literature. The length of the object in that instance, however, approximated only 1 inch, and it did not travel beyond the jejunum before instituting symptoms calling for immediate remedial attention.

That such a daggered object as was recovered from this patient could have traveled the entire course of a distensible tube of comparatively small diameter without causing repeated major insults and permanent tissue damage before inaugurating symptoms demanding intervention, strains the imagination.

Paradoxically, this patient's convalescence was as serene and uneventful as though only a minor laceration of the abdominal wall had been sustained.

‡ ‡

HARKINS METHOD FOR CALCULATING PLASMA DOSAGE

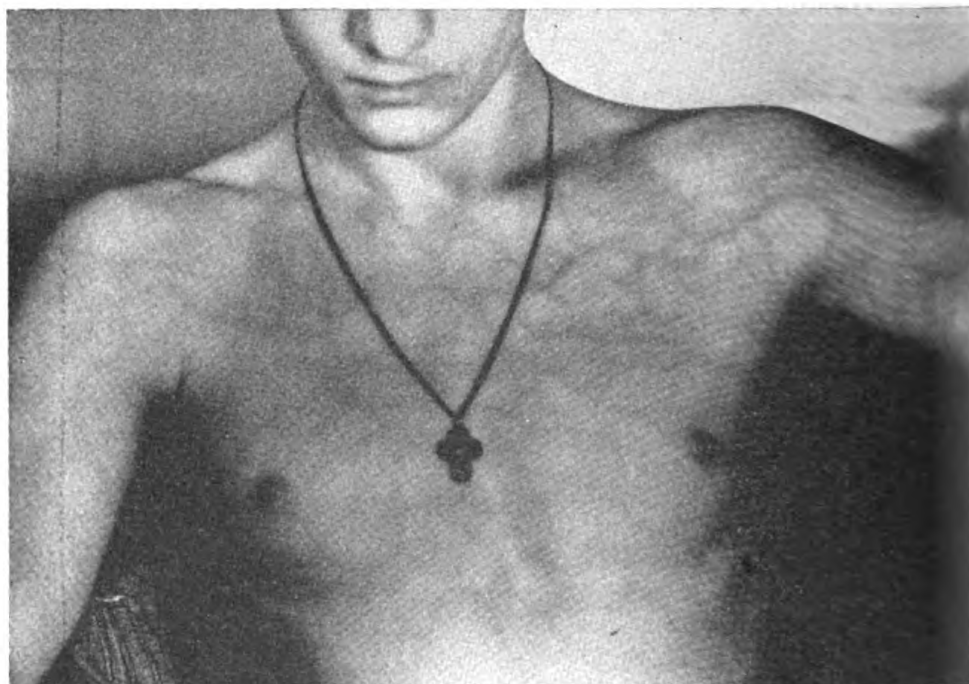
This is the simplest of the methods depending on extent of hemoconcentration. It is to give 100 cubic centimeters of plasma for every point the hematocrit exceeds the normal of 45. This formula can be adapted to hemoglobin estimations, in which the dosage should be 50 cubic centimeters of plasma for every point the hemoglobin exceeds the normal of 100 percent. The method involves the same assumption as the other methods, namely that the patient's pre-burn blood concentration was normal. The amount of plasma is calculated for adults, while for children it can be reckoned proportionately according to the body weight, the average adult weight being assumed to be 70 kilograms. When the plasma protein is below normal, the simplified method gives too low a value. If such a hypoproteinemia is present, an additional 25 percent of the calculated amount of plasma should be added for every gram the protein level is below 6.0 gm./100 cubic centimeters. In adequately treated cases experience has shown, however, that low plasma proteins are seldom observed in the first few weeks after a burn.—Hawkins, H. N.; Lam, C. R.; and Romence H.: Plasma therapy in severe burns. Surg., Gynec. & Obst. 75: 410-420, Oct. 1942

PRIMARY THROMBOSIS OF THE AXILLARY VEIN DUE TO STRAIN¹

SAMUEL J. STABINS

Lieutenant Commander (MC), U. S. N. R.

Ever since Matas (1) in 1934 published his comprehensive review "on so-called primary thrombosis of the axillary vein caused by strain" there have appeared in the literature from time to time additional case reports. Such reports strongly suggest that this condition occurs much more frequently than we have been led to believe. In the July 1942 issue of the *BULLETIN* there is a report of a case by Keener, Canty,

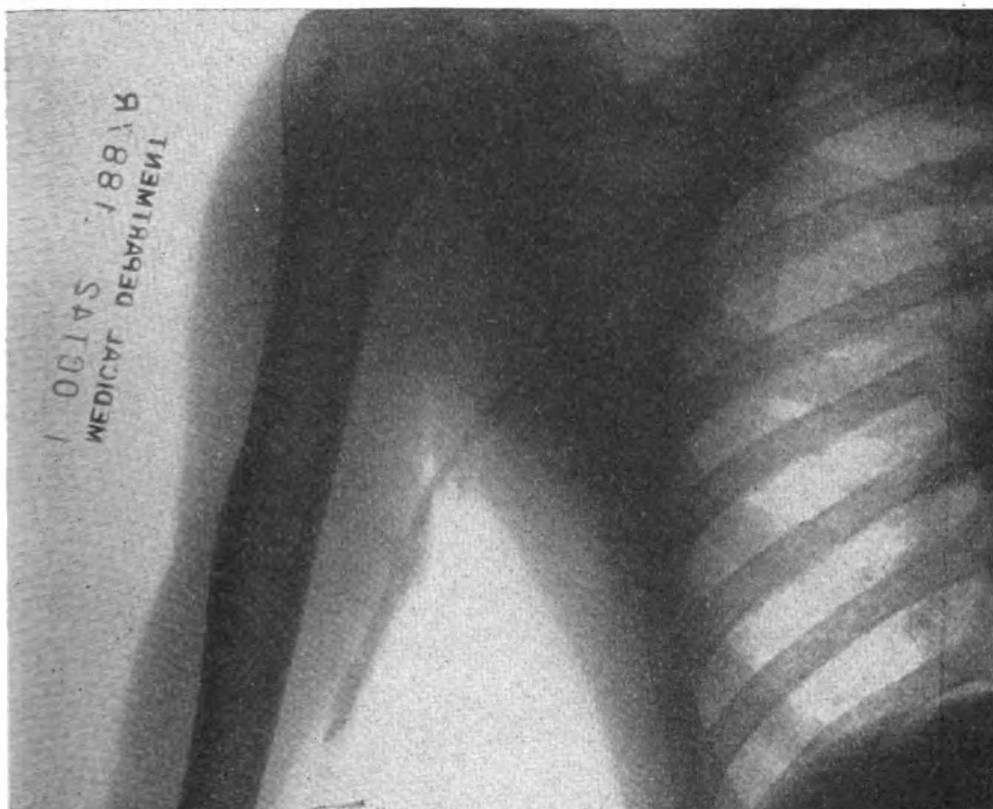


1. INFRA-RED FILM TAKEN SEVERAL DAYS AFTER ADMISSION SHOWING THE DIFFUSE SUPERFICIAL CIRCULATION OVER THE LEFT SHOULDER REGION.

and Prevost (2) occurring in a deep-sea diver in which the strain appeared to be due to the great effort of moving about on the sea floor and his pulling himself up on the line, hand over hand. This condition was first described by Schrotter in 1884 and although others have subsequently written upon the subject, it was not until Matas' article that this clinical entity began to appear in the *American journals*.

¹ Received for publication January 16, 1943.

The lesion predominantly occurs in the young or middle-aged males. This is because of their exposure to the type of work that involves heavy strain or effort; but it is safe to assume that as women become more involved in the fields heretofore banned to them, we shall see a corresponding decrease in the ratio. The right arm is involved much more often than the left; and when the latter is involved, the patient is either left-handed or was using his left hand almost exclusively at the time. Trauma not in the form of any direct blow to the axilla, but one in which the axillary vein is put on the stretch, seems to be the one



2. (CONTROL SIDE) SIXTEEN DAYS AFTER ADMISSION. FILM TAKEN 15 SECONDS AFTER THE INJECTION BEGAN. THE DYE IS SEEN CLEARLY IN THE MAIN AXILLARY VEIN. NO EVIDENCE OF ANY COLLATERAL CIRCULATION IS NOTED.

necessary factor. There has been no evidence to support any theory of changes in blood viscosity, or clotting time as a predisposing factor. Blood studies in this case were well within normal limits. Lowenstein (3) using cadavers as the basis for his study, came to the conclusion that he had reproduced this condition in many individuals by abducting and extending the arm to the point where the costocoracoid ligament and subclavius muscle indented the axillary vein as much as 3 millimeters. He was of the opinion that this indentation caused a distention of the vein with subsequent rupture of the vessel wall and thrombosis. It would seem more logical to suppose from his experi-

ments that interference with venous return as a result of this distention and not any actual rupture of the vessel wall was a major factor in producing the thrombosis. Cottalorda (4) believed that venospasm was responsible for the thrombosis, in that the trauma set up a sympathetic irritation. This theory is an interesting one in the light of the recent work by Ochsner and DeBakey (5) on thrombophlebitis. It is quite likely that there is a sympathetic nerve effect present in these cases. It is known that irritation either on the arterial or venous side causes spasm of the vessels. It would seem as if injections of the sympathetic chain might lead to relief of this spasm, but so far as I know this has not been done for this condition.



3. (CONTROL SIDE) SIXTEEN DAYS AFTER ADMISSION. FILM TAKEN 2 MINUTES AFTER INJECTION WAS FINISHED. NO DYE IS NOTED ALONG THE COURSE OF THE AXILLARY VEIN. THIS REPRESENTS A NORMAL EMPTYING OF THE VEIN.

The diagnosis is readily made if one is aware of this clinical entity. A history in an individual not acutely ill who recalls a sudden strain or prolonged effort, followed in a few hours by dull pain in the armpit and subsequent swelling of the arm, warrants this presumptive diagnosis. The arm is swollen and firm. The skin is bluish or bluish-purple, and many dilated superficial veins are noticeable about the pectoral region and midaxilla. Infra-red photography visualizes the extent of this collateral circulation, and whenever these superficial

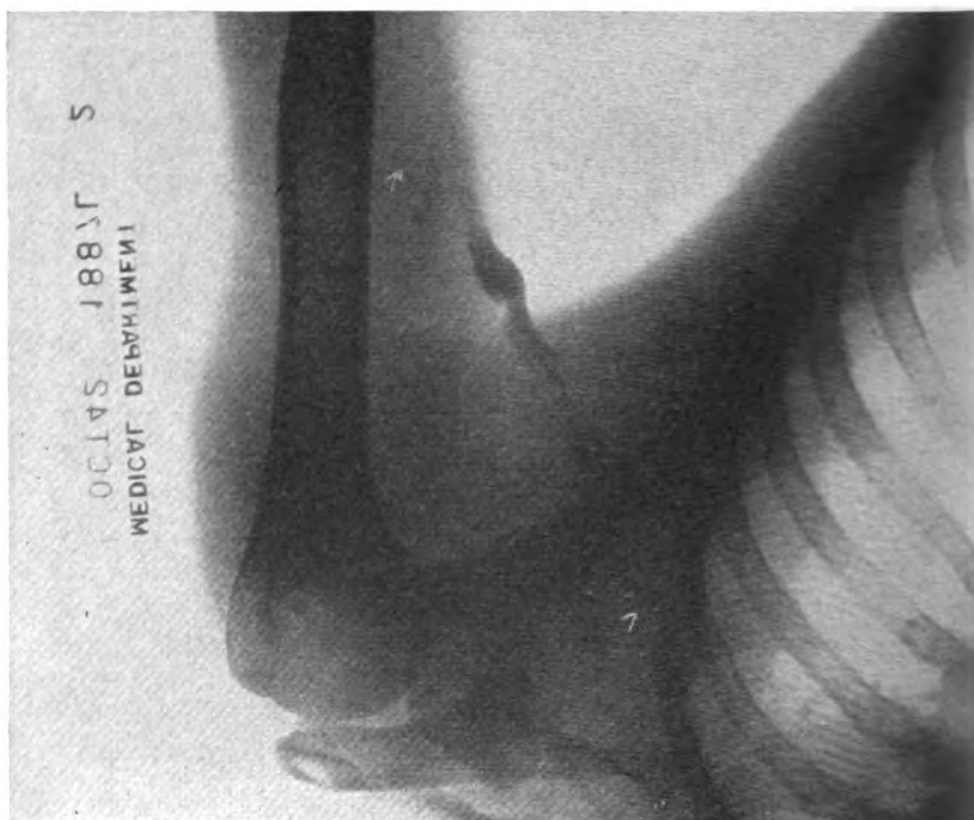
veins are noted, such films should be taken. One can always feel a firm, tender cord corresponding to the course of the axillary vein. There are no signs of inflammation in the vein itself or the surrounding tissue. The pulse and blood pressure in both arms, according to most observers, vary little, and in this case the blood pressure was not recorded. It did not seem to the writer that it was of any practical value so long as the pulse was easily obtainable and, on the contrary, it was felt that the possibility of disturbing the thrombus offset any benefit that might be derived.



4. (INVOLVED SIDE) SIXTEEN DAYS AFTER ADMISSION. FILM TAKEN 15 SECONDS AFTER THE INJECTION BEGAN. THREADLIKE PROXIMAL AXILLARY VEIN IS READILY SEEN WITH NUMEROUS TRIBUTARIES PRESENT.

Increased venous pressure on the affected side is usually noted as well as a decreased oxygen saturation of the venous blood. Blood studies usually are well within normal limits. The use of a radiopaque dye intravenously to visualize the site of the obstruction and the adequacy or inadequacy of the collateral circulation, is a safe and very important test. It not only is of value in obtaining the above information but should be repeated from time to time to determine the adequacy of the collateral circulation. In this case repeated recheck films clearly show that the collateral circulation is functioning so well that 2 minutes after the injection was finished practically no dye was present in the obstructed axillary vein.

There are three schools of thought relative to treatment. There are some who feel that immediate surgery with ligation, or ligation and resection of the thrombosed segment should be performed. I see no justification for the adoption of this principle. The one real justification for immediate interference would be the possibility of embolus, but a review of the literature fails to reveal that this ever occurs as a result of a trauma in the upper extremity. The disadvantage is that it is practically impossible to remove the entire segment; and if one could it would probably be much more extensive than appears on the surface.



5. (INVOLVED SIDE) SIXTEEN DAYS AFTER ADMISSION. FILM TAKEN 2 MINUTES AFTER INJECTION WAS FINISHED. IN CONTRAST TO FIGURE 3 IN WHICH NO DYE IS SEEN, THE AXILLARY VEIN IS CLEARLY DEMONSTRABLE. THIS INDICATES THAT THE COLLATERAL CIRCULATION IS NOT SUFFICIENTLY DEVELOPED TO COMPENSATE.

The second school of thought believes in conservative handling from the beginning without ever resorting to surgery. The third school of thought, which I personally favor, is to treat them conservatively early, and later on to remove the thrombosed segment. If the segment is allowed to remain, not only does the patient have symptoms either continually or intermittently, but this thrombosis may be the site for infection and future serious complications.

CASE REPORT

R. W. C., aviation machinist's mate, second class, age 23 years, was admitted to the hospital September 15, 1942.

History.—Patient states he was in excellent health until the day before admission. He was installing an airplane motor which required pulling very strenuously with a wrench. It necessitated keeping his hands over his head, and he distinctly remembers that he used his left arm exclusively, although he is right-handed. About one-half hour after finishing work he noticed stiffness and numbness of the left arm with slight bluish discoloration of the upper arm. The entire arm became swollen. He noticed that the veins of the arm became prominent, and during the night the pain became intense, the arm became more swollen, and he felt a "tender knot" in the left axilla. He reported to sickbay the following morning and was referred to the hospital for treatment.

Physical examination.—The patient did not appear acutely ill. The temperature was 97.6° F., pulse 72, respiration 20. Findings were negative except for the local condition. The left arm appeared swollen and distended with enlarged superficial veins. These veins extended over the shoulder region and along the pectoral and midaxillary portion of the chest wall. The skin was bluish-purple in color, and no appreciable difference in skin temperatures could be made out. On the inner side of the upper left arm there was a firm, indurated, tender cord extending deep into the axilla. No increased heat was noted over this area. Blood-pressure determinations were not taken on admission as it was felt inadvisable to disturb the local situation. Subsequent readings, however, failed to reveal any appreciable difference. Measurements of the arms, forearms, and hands are shown in table 1:

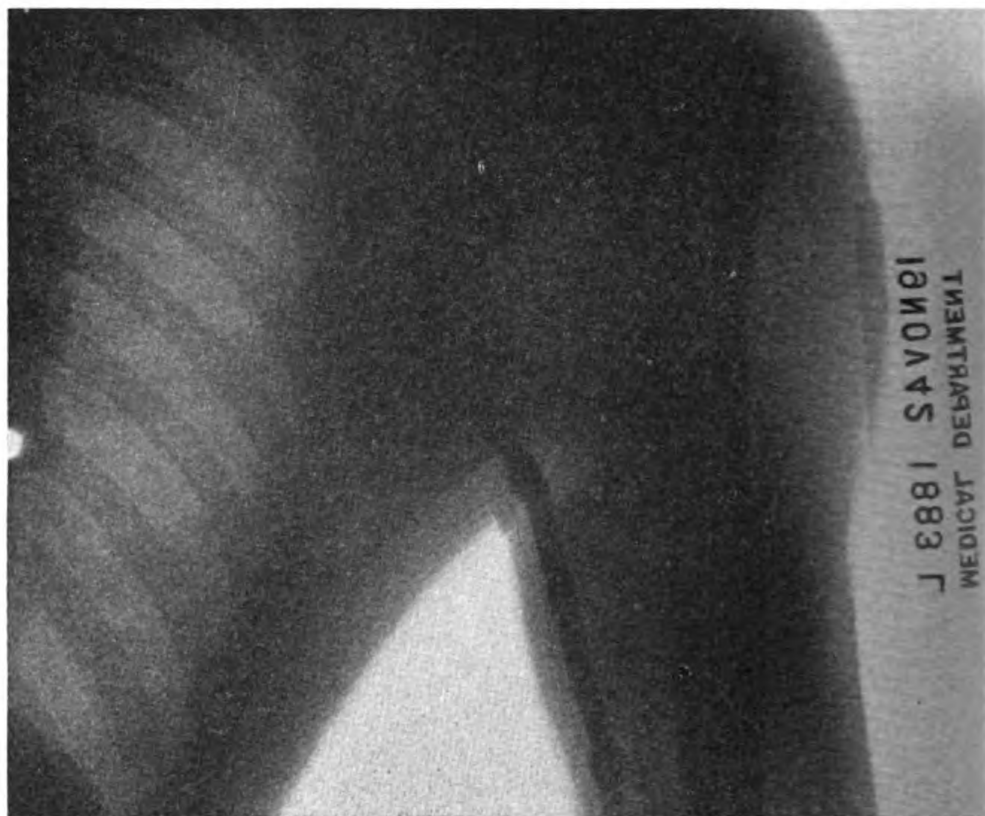
TABLE 1.—*Arm measurements of control and involved side*

Date	Biceps area		Forearm		Hand	
	Control	Involved	Control	Involved	Control	Involved
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
Sept. 16, 1942.....	10½	13	9	11	9	10
Sept. 18, 1942.....	10½	13½	9	11½	9	9½
Sept. 30, 1942.....	10½	12	9	9¾	9	9½
Oct. 8, 1942.....	10½	11¼	9	9¾	9	9
Dec. 12, 1942.....	10½	11¼	9	9¾	9	9¾

Blood studies were normal in all respects. A diagnosis of primary axillary thrombosis of the left axillary vein was made. Because of the extensive involvement of the process, surgery for the removal of the thrombosed segment was considered inadvisable. Conservative therapy was decided upon.

Clinical course.—The arm was put up in an airplane splint with immediate and prompt relief. The arm and forearm became much less swollen. Infra-red photographic studies taken several days after admission clearly revealed the collateral venous circulation (fig. 1). On October 1, 16 days after admission, x-ray studies with diodrast were made to visualize the venous circulation in both arms (figs. 2, 3, 4, and 5). Films were taken 15 seconds after injection began and 2 minutes after the injection was finished. Thirty cubic centimeters of radiopaque dye was used in each arm, and 20 seconds was allowed for the injection. Figures 2 and 3 represent the normal side. Figure 2, taken 15 seconds after the injection began, shows the dye in the main vein without any

evident collateral circulation. Figure 3, taken 2 minutes after the injection was finished, reveals almost a complete emptying of the vein as evidenced by the absence of the dye. Figures 4 and 5 represent the involved side. Figure 4, taken 15 seconds after the injection began, reveals evidence of a collateral circulation and a threadlike injection of the dye high up in the axillary vein. This area represents the site of the thrombosed segment. In figure 5, which was taken 2 minutes after the injection was finished, it is evident that the collateral circulation is far from adequate, and a good deal of the dye is still present in the main vein proximal to the site of thrombosis. The patient was kept in the airplane splint until October 23. Measurements of the arms were taken at in-



6. (INVOLVED SIDE) SIXTY-FIVE DAYS AFTER ADMISSION. FILM TAKEN 15 SECONDS AFTER INJECTION BEGAN. THE THREADLIKE PROXIMAL VEIN IS SEEN AND THE COLLATERALS ARE MUCH LARGER IN SIZE THAN PREVIOUSLY. THE COLLATERAL VEINS ON THE CHEST WALL APPROACH THE AXILLARY VEIN IN SIZE.

tervals and revealed a gradual decrease in the swelling on the involved side. He was put on light duty with improvement in the function of the left arm. On November 19, recheck films of the involved side were made under the previous technic (figs. 6 and 7). Figure 6 reveals the threadlike axillary vein with the collateral vessels markedly enlarged. Figure 7, taken 2 minutes after the injection was finished, shows that an adequate collateral circulation has been established as evidenced by the almost complete absence of dye. He was discharged on December 7, on his eighty-third hospital day.

Following discharge from hospital, patient continued to have some weakness in the left arm. The superficial collateral veins of the left arm and shoulder remained about the same. Operation was performed on March 24, 1943. The

axillary vein was ligated and resected. Immediately the deep veins began to dilate and within 6 hours the superficial collateral circulation had disappeared. The left arm did not increase in size. He has made an uneventful recovery and is to be discharged to duty shortly. The course of events subsequent to ligation and resection further strengthen the belief that venospasm played a major role in this instance.

CONCLUSIONS

1. A case of primary thrombosis of the axillary vein is reported.
2. The intravenous use of a radiopaque test to determine the site of obstruction and the adequacy of the collaterals is considered to be a safe and important adjunct in the care of this condition.



7. (INVOLVED SIDE) SIXTY-FIVE DAYS AFTER ADMISSION. FILM TAKEN 2 MINUTES AFTER INJECTION WAS FINISHED. NO DYE IS NOTED INDICATING A SATISFACTORY COLLATERAL CIRCULATION HAS BEEN DEVELOPED.

3. A combination of early conservative treatment followed by resection of the thrombosed segment many months later is considered the treatment of choice.

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PYOGENIC SPINAL EPIDURAL INFECTIONS¹

HAROLD F. BUCHSTEIN

Lieutenant Commander (MC) U. S. N. R.

Certain neurologic lesions produce clinical syndromes which are so characteristic that even though they occur but seldom they may readily be recognized by any clinician aware of their existence. Pyogenic infections of the spinal epidural space are just such lesions. Their prompt recognition is vital, since immediate surgical intervention is required if permanent disability and possible death are to be avoided.

The spinal epidural space, that narrow interval between the spinal dura mater and the bony walls of the vertebral canal, is occupied by a small amount of fatty tissue in which lies a rich plexus of veins. Pyogenic infections may gain entrance to this space in two fashions. Some result from the direct extension of a contiguous lesion, such as a carbuncle or a perinephritic abscess. More commonly, however, they arise through the lodgment in the spinal epidural space of septic emboli from a distant focus. The primary focus may entirely escape the notice of the clinician or may be regarded by him as simply an unrelated concomitant of the intraspinal lesion.

The character of the lesion formed in the spinal epidural space will vary with the number and virulence of the organisms present and with the resistance of the host. Most frequent are circumscribed collections of purulent material, commonly known as acute spinal epidural abscesses. Others are partly or wholly granulomatous and represent a more chronic aspect of the disease. The staphylococcus is the responsible organism in most instances; pneumococci and other pyogenic organisms are found less frequently.

By virtue of their formation within the vertebral canal these lesions may act as spinal cord tumors and compress the spinal cord. Actually, however, they produce symptoms chiefly by invading the spinal nerves and their accompanying blood vessels. Occlusion of these vessels and the epidural venous plexus causes circulatory stagnation within the spinal cord, with resulting secondary myelomalacia. This accounts for the poor functional recovery which may follow relief of

¹ Received for publication December 21, 1942.

pressure by laminectomy, and stresses the need for surgical intervention at the earliest possible moment.

CASE REPORT ²

A 14-year-old boy fell from a truck, striking the midthoracic region of his back. There was no immediate pain or disability, but a week later he developed severe pain in the region of the blow. Presently the pain radiated around the right side of his chest. This became more intense, and the patient was confined to his bed by the severity of the pain occasioned on movement or on manipulation of his thoracic spine. Fever, anorexia, and general malaise developed. A diagnosis of pleurisy was considered by his physician. Five days before coming to the hospital subjective numbness appeared in both feet, and both legs were found to be weak.

Upon admission to the hospital the patient was acutely ill, having a temperature of 101° F. A red and tender swelling was present just to the right of the fourth thoracic spinous process. The thoracic spine was rigidly splinted, the patient crying out at any attempt to move him for examination. The scars of many boils were noted on the patient's back, and inquiry elicited the information that he had had recurring crops of boils for several years. Neurologic examination showed a marked weakness of both lower extremities and an impairment of all forms of sensibility below an ill-defined sensory level in the lower thoracic region. The deep reflexes were hyperactive in the lower limbs, and the Babinski reaction was bilaterally positive. The patient required catheterization.

Laboratory studies of the urine disclosed no abnormality. The blood contained 20,300 leukocytes per cm., 74 percent being polymorphonuclear forms. Wassermann reaction was negative. X-ray studies of the chest and thoracic spine did not disclose any abnormalities.

Lumbar puncture, on the day of admission, showed the presence of a complete block of the spinal subarachnoid space. The fluid obtained was yellow in color and contained over 300 mg. of protein percent. The cell count and sugar content of the fluid were normal, and no organisms were found on smear or culture.

A diagnosis of spinal epidural infection was made and immediate operation ordered. A laminectomy was carried out at the level of the cutaneous swelling. The erector spinae muscles beneath the swelling were the seat of an extensive granulomatous process, and the vertebral spines and laminae were soft and somewhat necrotic. When the epidural space was entered it was found to be occupied by a granulomatous mass which measured 6 mm. in thickness over the dorsal aspect of the

²From the division of neurosurgery, department of surgery, University of Minnesota Medical School.

spinal dura. Four pairs of laminae were removed before the ends of the lesion were defined. The granuloma was exceedingly vascular and contained numerous pockets of purulent material. By blunt dissection a trough was cut through the mass, exposing the dura in the midline. The dura was not opened. A gauze pack was introduced to control bleeding, and the wound was loosely closed. A transfusion of blood was given during the operation.

A blood culture taken the day after operation yielded a growth of staphylococci, as did cultures taken from the lesion at the time of operation. The pack was removed the day after operation and sterile powdered sulfapyridine was placed in the wound. Intensive chemotherapy was instituted systemically as well. The patient's temperature rose to 103.4° F. postoperatively but thereafter subsided progressively to normal. A second blood culture taken a week later was sterile. Two additional transfusions of blood were given during the postoperative course. The wound was allowed to heal from the bottom, the skin being closed after the muscular layer had united.

The patient's pain was relieved immediately following operation, and a progressive return of power and feeling in the lower extremities ensued. Within a month he was able to walk with assistance and was allowed to go home. When last seen in the out-patient department, 6 months after operation, he walked well and reported that he did all of his farm chores and could indulge in sports which did not require running. A mild degree of spasticity persisted in the lower extremities.

COMMENT

This case illustrates the most common source of metastatic spinal epidural infections, namely, an infection of the cutaneous tissues, in this case chronic furunculosis. Paronychia, infected blisters, and cellulitis are other possible sources. Less commonly the primary focus may be in the respiratory tract, paranasal sinuses, or teeth. Every patient presenting signs and symptoms of spinal nerve root irritation and spinal cord compression, particularly if they are of recent and rapid onset, should be quizzed and examined for the presence of infectious processes, either active or recently healed. Any such infection immediately suggests the possibility of a spinal epidural infection.

The role of trauma to the spine in precipitating these metastatic infections may be dramatic, but such a sequence of events is not always present. Many patients give no history of local trauma. Some date the onset of their trouble from a respiratory tract infection; others are aware of no precipitating agent. The interval between such an event and the onset of symptoms referable to the spinal cord and nerves is variable, ranging from days to many weeks,

The presenting symptoms of a spinal epidural infection are those of vertebral infection plus those of nerve-root irritation. When the nerve root pains are in the thoracic or lumbar region, as they most commonly are, they are often mistaken for symptoms of visceral disease, as was true in this case. The presence of local pain and tenderness in the spine in addition to the radiating root pain should aid in making the diagnosis. The most striking physical finding, prior to the onset of motor and sensory paralysis, is the exquisite local tenderness and rigidity of the spine. The patient is loath to permit the involved region to be touched.

When the signs of spinal paraplegia appear, namely, ascending numbness and weakness with retention of urine and feces, the intraspinal inflammatory process is well advanced, and irreparable damage to the spinal cord may already have been done. The need for immediate surgical intervention once the diagnosis has been made scarcely requires comment. A laminectomy should be performed at the site of maximum local tenderness of the spine, this being a much more reliable guide to the site of the lesion than is the sensory level determined by neurological examination. It should not be necessary to inject iodized oil or air into the spinal subarachnoid space to localize these lesions. If a more or less liquid collection of purulent material is found in the epidural space it may simply be drained at the point of exposure. If the lesion is granulomatous it should be unroofed completely and either removed by blunt dissection or a trough cut through it down to the dura. The dura must not be opened. The wound should be left open to permit free drainage; it may be closed secondarily if necessary. A sulfonamide drug, preferably sulfathiazole, should be instilled in the wound and administered systemically in adequate dosage. If time permits, administration of the drug should be begun before operation, since manipulation of the lesion will almost certainly send a shower of organisms into the blood stream. Most of these patients have a secondary anemia. Blood transfusions during and after operation are a valuable supportive measure.

Without surgical drainage, acute pyogenic infections of the spinal epidural space are almost invariably fatal. Even with drainage the mortality has in the past been high (35 percent in a group of 31 cases collected from the literature by Campbell (3)), and of those who survived only one-half made a satisfactory functional recovery. Recent years have seen a decided improvement in the results obtained. This improvement may be attributed chiefly to earlier diagnosis and to surgical drainage of the lesion. Specific chemotherapy is a valuable adjunct, particularly in preventing the spread of the infection and in hastening recovery, but it in no way mitigates the necessity for immediate surgical drainage once the diagnosis has been made,

SUMMARY

Pyogenic infections of the spinal epidural space are of infrequent occurrence. They present a characteristic clinical picture which permits their ready recognition. The onset is with local pain and tenderness in the spine, plus nerve-root irritation, in a febrile and acutely ill patient, followed by rapidly progressive signs of spinal-cord involvement. A history of preceding local trauma to the spine and of cutaneous infections is frequently obtained.

This condition constitutes a very real surgical emergency. Immediate laminectomy and drainage of the lesion must be undertaken if fatality or permanent paralysis is to be avoided. The addition of modern chemotherapy and supportive measures to such surgical treatment should assist in further lowering the high mortality and morbidity rates formerly associated with these infections.

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THE LOCAL USE OF MICROCRYSTALLINE SULFATHIAZOLE IN THE TREATMENT OF FEMALE GONORRHEA AND AS A PROPHYLAXIS FOR GONORRHEA ¹

HAROLD E. STEDMAN
Commander (MC) U. S. N. R.

Oral therapy in the treatment of gonorrhea in the male and female with sulfathiazole has become well established. However, the extremely favorable results that we have observed in the local use of sulfathiazole in all types of traumatic wounds suggested to us the possibility of its local use in the prophylaxis and treatment of this infection. This paper is a preliminary report of our observation in the local use of sulfathiazole in the treatment of gonorrhea in the female and of its prophylactic use in 200 cases in the male. We have used the microcrystalline preparations of sulfathiazole because of ease of application, its property of remaining in a milk-like suspension, and because it does not have the tendency to clump and cake found in the ordinary powder preparations.

¹ Received for publication January 11, 1948.

We had the opportunity of observing this form of therapy in a small group of native women who were the source of gonorrheal infection in the military forces of both the Army and Navy. The Army medical staff was confronted with the problem of treating the native women with local therapy because it was considered unsafe to give the natives tablets of sulfa drugs unless very closely supervised, which was impractical. For various reasons they could not be hospitalized and they lived too far away to attend the hospital three or four times a day to receive individual doses of the sulfa drugs. If given enough tablets for the daily dose, they might save them for several days and take them all at once, or give them to their neighbors or children, or throw them away.

A survey was first made by the Army medical staff and out of about 60 women who had been treated at one time or another during the past 3 years, 17 were found to be infected. These were immediately started on local therapy consisting of daily douches of 5 percent lysol solution followed by swabbing of the cervix and vagina with acriflavin 1:2000. Twelve cases responded to this therapy, and treatment was discontinued after 3 weekly urethral and cervical smears were negative. Five did not respond after 3 or 4 weeks of this form of therapy.

The senior medical officer of this hospital ship had established a prophylactic station ashore to provide facilities for all ships and shore activities in the area. The next effort was directed toward the control of all possible sources of infection. As the Army had established a venereal clinic for women every effort was made to locate these women and, with the aid of the local police, to see that they were sent in for treatment. It was through the collaboration with the Army medical officers that the subjects for this study were made available. This group of five cases who remained smear-positive, and all other subsequent cases, provided the clinical material for a trial of local sulfathiazole therapy, which was at once safe and simple in its applications.

Women were seen daily. Urethral and cervical smears and cultures were taken. The smears were all positive for gram-negative intra- and extra-cellular organisms but the cultures were useless because of an overgrowth of ordinary bacteria. This was due to lack of special laboratory equipment and therefore could not be improved. The work was continued however, using smears as criteria for treatment and cures. It is fully realized that without cultures accurate conclusions cannot be drawn but since the method shows evidence of value it seems worth while to make this preliminary report.

METHOD OF TREATMENT

1. Treatments were given once daily. The mucopurulent exudate was removed from the cervix and vagina with a dry sponge.

2. Three methods of application of microcrystalline sulfathiazole were used.

(a) The cervix and vagina were coated with a layer of microcrystalline sulfathiazole using a powder blower, or

(b) Two or 3 cubic centimeters of a 5 percent solution of microcrystalline sulfathiazole was instilled into vagina, or

(c) A suppository of 10 percent microcrystalline sulfathiazole was inserted into the vagina. The suppository we found most satisfactory was made as follows:

	Gm.
Sulfathiazole-microcrystalline	0.2
Glycerinated gelatin, U. S. P. ....	.9
Glycerin, U. S. P. ....	.9

Misce et fiat: Supp. vag. weight, 2 gm.

Manipulation: Triturate sulfathiazole with the glycerin. Heat glycerinated gelatin on a water bath until melted. Add the sulfathiazole and glycerin mixture to the melted glycerinated gelatin and incorporate thoroughly. Place in molds and allow to cool and solidify.

This suppository takes about 10 minutes to dissolve, spreads out over the entire cervix and vagina, and remains for several hours. The glycerin suppository was found to be the best form of application.

3. About 5 cubic centimeters of a 5 percent suspension of microcrystalline sulfathiazole was instilled into the urethra.

This plan of treatment was followed in 13 cases, using as our only available criterion for cure, 3 negative cervical and urethral smears at weekly intervals after discontinuance of therapy. Of the 5 cases who remained smear positive after 4 weeks of douche and local acriflavine therapy, negative smears were obtained in 8, 11, 18, 20, and 31 days, respectively. The latter case had a marked chronic endocervicitis. She remained smear-positive until a small battery cautery was assembled and the cervix cauterized. Rapid improvement with a negative smear followed this therapy. The plan of treatment as outlined above was used in eight previously untreated cases of gonorrhea and negative smears were obtained in 8, 10, 10, 11, 13, 16, 18, and 20 days. There is reason to believe that the last patient was probably reinfected during the early period of her treatment. After her activities were restricted by hospitalization, negative smears were obtained in 10 days.

Local sulfathiazole therapy caused the patients no inconvenience except the necessity of daily attendance at the "clinic." There was no evidence of any irritation or inflammatory reaction due to the local use of the drug. As a matter of fact mild cases of endocervicitis improved rapidly. The profuse mucopurulent discharge rapidly disappeared, and after 3 to 4 days' treatment there remained only a clear mucous plug at the cervix or a small amount of thin mucous secretion. Likewise the purulent discharge which could be expressed from Skene's glands rapidly changed, at first to a cloudy watery secretion and finally disappeared.

Although we are aware that our criterion of cure without culture is open to criticism, we were able to follow a number of our earlier patients who returned to prostitution as soon as they were discharged from treatment. During 6 weeks of observation there were no fresh cases of gonorrhea traceable to them. The exigencies of the service did not permit further observations.

We also realize that our series of cases is small and our observations of short duration, but we are convinced that the local application of microcrystalline sulfathiazole offers an effective method of treatment of gonorrhea in the female. We realize that the systemic administration of the drug is a more convenient method of therapy in the usual case, but suggest a trial at local therapy in resistant cases. Since our observations show that the local application of microcrystalline sulfathiazole to the vagina is not injurious, and has shown curative value, it seems logical that it may be used as a prophylaxis in gonorrhea. Its introduction into the vagina in the form of a suppository might offer protection both to the male and the female. Opportunities for observations of this prophylactic measure are lacking to us, but it may be that others may be able to carry out studies in this regard.

LOCAL MICROCRYSTALLINE SULFATHIAZOLE AS PROPHYLAXIS IN THE MALE

Because of the apparent response to local therapy with sulfathiazole in the female, it was felt that this form of application should be valuable in the prophylaxis of gonorrhea in the male. With this in mind prophylaxis was begun on a group of exposed men. The first 100 men had both urethral instillations and oral dosage. Because it has been shown that sulfathiazole taken orally for 1 day following exposure will prevent a large percentage of infections, both avenues were used in order to determine the irritating effect on the urethra, and at the same time give a reasonably safe prophylaxis. No cases of gonorrhea developed in this group, and only one case developed what appeared to be a chemical irritation. This patient had a slight discharge for a few days with mixed organisms but no gonococci.

Method of prophylaxis with microcrystalline sulfathiazole:

1. Wash thoroughly with soap and water.
2. Dry thoroughly.
3. Urinate.
4. Instill $1\frac{1}{2}$ cc. 5-percent microcrystalline sulfathiazole into urethra and seal meatus with collodion. As it takes a few minutes for the collodion to dry, the solution is held in the urethra with a penile clamp until the collodion dries.
5. Patient to hold urine as long as possible. This may be overnight or at least 4 to 6 hours if the patient does not drink water.
6. Calomel ointment is applied in the usual way as a prophylaxis against syphilis.

Having found that chemical irritation is not a serious complication, the method was continued but without oral dosage.

Two hundred ninety-seven men received this form of prophylaxis in a community where gonorrhea was known to be present. Two cases of gonorrhea occurred in this group. One patient took the prophylaxis on the first night of liberty. He had liberty on the two succeeding nights but denied exposure, which may be questioned. The second patient developed a discharge within 48 hours of exposure in spite of the prophylaxis. This seemed to be a very virulent strain, but responded subsequently to oral sulfathiazole. The method of prophylaxis in this case seemed to have been carried out properly and the solutions were retained for 7 hours. No explanation for failure can be given.

This group of prophylaxis is too small from which to draw any conclusions other than to say it shows promise of being very valuable. It is hoped that the method may be used on several thousand men during which time the optimum concentration of the drug, the length of time necessary to hold the solution, the maximum delay following exposure, and many other questions may be answered.

SUMMARY

1. Observations are presented concerning the local use of microcrystalline sulfathiazole in the treatment of gonorrhea in the female and its prophylactic use in the male.

2. Thirteen cases of female gonorrhea responded to this form of therapy, five of which were resistant to other forms of local therapy. No harmful effects were noted.

3. In 297 males, prophylaxis by the urethral instillation of a 5 percent suspension of microcrystalline sulfathiazole was effective in all but two cases (99 percent).

4. The use of vaginal suppositories of microcrystalline sulfathiazole is suggested as a prophylaxis against gonorrhea in order to protect both parties of the sexual union.

The author of this paper is indebted to Commander L. Kraeer Ferguson (MC), U. S. N. R., whose work in the use of microcrystals of sulfathiazole has been published recently in the *BULLETIN* and the *Journal of the American Medical Association*, for original suggestion and invaluable advice and assistance in carrying out this study.

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TANK CASUALTY ¹

▲ CASE REPORT

EDMUND T. RUMBLE, JR.
Lieutenant (MC) U. S. N. R.

and

JUDSON A. MILLSPAUGH
Lieutenant Commander (MC) U. S. N.

At 45 minutes after midnight, 12 severely wounded men were transferred from a tossing barge to the sickbay of this vessel.

This is the account of 1 of these 12, given largely to show what the human frame can endure and yet survive. He was one of a crew of 4 operating a light tank, when a shell penetrated and exploded. By some miracle the driver escaped injury. A second man received a compound, comminuted fracture of the upper third of the right femur. The third, a squadron officer, suffered a penetrating wound of the tibia without fracture. The last, the one to be described, had severely compounded, comminuted fractures in the upper third of both legs, with burns of face, hands, and thighs.

In shock, bleeding from his shattered legs, he was hauled through the top of the tank by the driver and the squadron officer. His survival during the rigorous and shocking trip to this ship, which took approximately 18 hours, was test enough that he had the vitality and stamina to withstand the accidents and surgical procedures which took place during the following weeks.

Laid on a blanket after removal from the tank, he was dragged across a field by his comrades. His legs dangled in the grassy stubble as he was hauled over a knoll in a sheep pasture toward the tank rendezvous area some distance away. Here his first medical care was given. Tourniquets were applied, dressings were wrapped around his severely compounded fracture wounds, tannic acid jelly smeared on his burns, and a Syrette of morphine tartrate administered.

Still without splints or support to his legs he was lifted to the top of another tank. On this he was driven to the medical section of the naval beach party. Thomas splints were applied, sulfanilamide powder used on the wounds, and dressings changed. His pulse, small, rapid and indefinite, improved after an infusion of 250 cc. of human plasma. Hours later, still on the beach, this procedure was repeated with equally encouraging results. Then, placed on an Army litter, he, along with 14 other wounded men, was carried aboard a tank lighter.

¹ Received for publication January 26, 1943.

There was an hour of slapping and tossing through a high surf and choppy sea to the side of the ship. Almost another hour elapsed before the barge, banging against the ship's side, could be hoisted to the ship's after well-deck. A second dose of morphine had been administered during the trip from the beach to the sickbay. However, the banging and jarring, and the splashing of cold salt water and rain on the wounded lying in the bottom of this open boat nullified most of the effect of the drug.

On the examining table his face was charred, his eyes sunken and pupils tiny. Respirations were slow and shallow. The burns on his upper extremity involved the dorsum of the hands, wrists, and forearms; and, like those on his face, appeared to be first and second degree. Without disturbing the splints, but exposing the lower extremities, it was seen that the burn of his right thigh was more severe, extending over the lower half laterally and posteriorly.

The wounds of both legs were remarkably similar, except that the right was larger and deeper than the left. After sponging out the blood it was apparent that the tibia and fibula on both sides had been badly comminuted with considerable loss of bone. Further inspection revealed that medially the tibialis posterior muscle and apparently some of the bellies of the long flexors were completely missing. Anteriorly and laterally the tibialis anterior and all the long extensor muscle bellies were blasted away. Undoubtedly the anterior tibial vessels and the deep peroneal nerve were destroyed, as they lie anterior to the interosseous membrane between the tibia and fibula. Certainly on the right side the peroneal artery lying posterior to the fibula was also intercepted, as this wound lay open laterally and posteriorly somewhat more so than the wound on the left. His feet were cold. There was no sensation or movement of the ankle or toes on either side. Hemoglobin was 45 percent, blood pressure 80/60. For 9 hours the patient remained recumbent and undisturbed except for taking fluids. During 34 hours he was given on three occasions 250 cc. of plasma, and twice 500 cc. of 5 percent dextrose in saline. Every 8 hours $\frac{1}{2}$ grain of morphine was administered. Also, during that time he received a prophylactic dose of tetanus antitoxin and gas bacillus antiserum, and $\frac{1}{2}$ cc. of tetanus toxoid. His blood pressure at this time was 110/80, and his pulse 108.

The response to supportive measures following such severe injury and unusual hardship was so remarkable that it was thought treatment of his legs could be instituted. His left foot was definitely warmer, but both were motionless and without sensation. Closed plaster technic with sulfathiazole was decided upon as the treatment of choice.

Under ether anesthesia the Thomas splints were removed and the skin of both legs thoroughly cleaned with green soap and water. Debridement of both wounds was carried out simultaneously. Obvious, accessible foreign bodies which consisted of bits of metal, clothing, dirt, and splinters of wood were removed. Putrid, greenish muscle was excised until bright, contractile tissue was reached. Loose bone fragments with greenish, soft, foul-smelling, bone matter were cut away. Five grams of sulfathiazole were sprinkled into each wound. Vaseline gauze was packed in them as rapidly and carefully as possible. Circular plaster casts were then applied extending from the base of the toes to the junction of the upper and middle third of the thighs. The man was returned to a Gatch bed in the sickbay, the encased extremities elevated, and 500 cc. of whole blood given by the indirect citrate method. With a blood pressure reading of 80/50 before the transfusion it gradually rose to 135/80.

During the next 48 hours the patient suffered great pain in his right leg. This was scarcely relieved by morphine in frequent $\frac{1}{2}$ grain doses. The right foot was ischemic. It remained blanched, cold, and swollen. His blood pressure by that time had fallen to 125/70. The upper half of the cast on the right lower extremity was removed. There was purplish mottling of the dorsal aspect of the foot, and numerous vesicles were evident on the distal half of the leg. Shortly after the upper half of the cast was lifted away, the color of the skin improved, but by the morning of the third post-operative day the right foot again was obviously lacking in proper blood supply. A greenish fluid filled the vesicles, mottling increased, and pressure on the toes produced no change in color. Meanwhile the blood pressure had fallen to 94/60, and the pulse was 124.

Three days after the debridement, a guillotine amputation was performed on the right lower extremity in the lower third of the thigh. Although the man had been given 250 cc. of plasma immediately before the amputation, and the procedure, done under a tourniquet, was practically bloodless, his blood pressure continued to drop and immediately after the operation was 80/50; his pulse 136. A transfusion of 500 cc. of blood was given with immediate improvement.

He responded to questions, felt comfortable, appeared bright and well out of shock. At least the amputation had improved his condition. But owing to a slip of technic, the transfusion of 500 cc. was completed in the regrettably short time of 11 minutes. Hemorrhage was anticipated as a result, and did occur, he hemorrhaging profusely before the bleeding was checked.

Three and one-half days following the amputation, a second hemorrhage occurred. This one, massive and gushing, came when he was tossed against a bulkhead by the ship's roll in a heavy sea. Apparently

from a sizable muscular branch in the vastus lateralis group, the clotted bright red blood filled the gap between his thighs much as an exsanguinating hemorrhage of parturition fills a bed. Delirious, gasping, pulseless and parched, it looked as though he were in extremis.

Quietly and speedily, however, a transfusion of 500 cc. of previously cross-matched blood was set up and ready to be given by the time the medical officer had ligated the open artery and redressed the stump. To the surprise of all, 6 hours later the man was rational, though weak, comfortable, but pale.

During the next 11 days the patient rapidly increased in strength. The burns of his face, hands, and forearms had practically healed. Ferrous sulfate, vitamins, sulfathiazole, and regular diet all played their part. The left leg, encased in plaster, was at all times comfortable. Browened and beginning to smell from the absorption of the discharge from the wound within it, the cast showed a normal thigh above its upper end and a normal foot below. There was sensation in the left foot and slight plantar flexion in the toes. Burns on the lateral and posterior aspect of the right thigh prevented the application of the important skin traction which hastens the healing of a guillotine stump. However, with the help of sulfathiazole and Dakin's solution the stump everywhere revealed bright healthy granulations. His hemoglobin, 30 percent the day after the second hemorrhage, was now 70 percent 11 days later. In the interval he had received 1,500 cc. of citrated blood in 6 equal transfusions. Forced to lie on his back for about 91½ days because of these injuries, operations, and accidents, a sizable bed sore formed over the sacrum. This was the source of his greatest annoyance as he left the ship 3 weeks after his arrival aboard.

MEDICAL AND SURGICAL DEVICES

PRACTICAL DEVICES EVOLVED AND USED IN A COMBAT AREA ¹

A JEEP AMBULANCE—A TENT-DUGOUT OPERATING ROOM—A METHOD FOR REMOVAL OF SHRAPNEL FRAGMENTS

JOHN K. PATTERSON
Commander (MC) U. S. N. R.

The following devices are not complicated in construction but were developed and have proved their worth under actual combat conditions. They all have the dual advantage of fulfilling a specific need in a medical company working in the field, and of being constructed without necessity for technical assistance and from materials readily available. This article is written in the hope that one or all of these improvisations by the author may prove of worth to others in similar circumstances.

A JEEP AMBULANCE

The jeep ambulance (fig. 1) essentially consists of a 2- by 8-inch frame, braced by 4 angle irons and bolted to the jeep body. Two by 6 lumber probably would be of ample strength if 2 by 8 were not available, although the latter gives more rigidity. The essentials of its construction are obvious at a glance. The following details are given for those wishing to construct a similar one:

The side pieces measure 6 feet in length; the end piece 4 feet 10 inches (the width of a jeep body). As is shown, no additional holes need be bored in the jeep body to secure the frame in place, as the holes for the top frame and top frame catch are used, the top and top frame catch being displaced to the outside of the frame. Bolts sufficiently long to reach through these and the 2 by 8 frame and the jeep body are then passed, and then through a 6-inch piece of drilled strap iron on the inside of the jeep body. This strap iron serves as a "washer" to keep the jeep body from bending. It is not essential. The frame is bolted to the jeep in such a manner that the top surface of the frame projects above the jeep body 2 inches. A 2 by 4 cross-piece, "lying on the flat," resting across the top of the jeep body, 4

¹ Received for publication April 10, 1943.

feet 10 inches long, is now held in place by screws through the side frame. This crosspiece serves to support the forward ends of the stretchers. The position on the frame in which the crosspiece is screwed is determined by the length between the legs of the regular issue ("army type") metal pole litter. This is almost exactly 3 feet 7 inches. But in securing the crosspiece, it is best to measure the distance from the 2 by 8 rear crosspiece forward, actually using such a litter, and setting the 2 by 4 crosspiece at such a distance that the legs of the litter are wedged tightly between the rear 2 by 8 and the forward 2 by 4 crosspieces. This will prevent any forward or backward sliding when in use.



1. JEEP AMBULANCE.

The spare wheel is removed, to be bolted later, in its usual off-center position, to the under surface of the projecting ambulance frame. Its metal holder is turned upside down and bolted back in place, as otherwise the holder projects upward and interferes with the ambulance frame. The projecting section of the ambulance frame is next "floored," by nailing a piece of 3-ply wood to its under surface. Two crosspieces of 2 by 4 are then nailed in place to support this floor and to hold the spare wheel. The rearmost crosspiece of those two is further supported at the center of the floor, as shown in the photograph, by an angle iron at each end. The forward crosspiece, resting on the handles at the rear corners of the jeep, thus preventing "whipping" of the frame up and down, does not require angle-iron support.

A canvas "skirt" is then nailed to the rear end of the frame to prevent mud being thrown from the rear wheels against the feet of the projecting stretchers. The canvas top of the jeep is lengthened, as

shown, by sewing to the free lower edge of the rear curtain a canvas extension, with tie ropes attached, to secure it over the feet of the stretchers. It is painted green. A similar canvas flap, which can be rolled down and tied in place over the rear jeep window, is now sewed in place. This is used only in case of rain.

Before placing the stretchers on the frame, it is well to notch the rear and forward crosspieces of the frame to correspond to the side bars of the stretchers. This keeps them from sliding from side to side. Notches for the Stokes-type stretcher are made on an angle to correspond tightly to its slanting side bars. This stretcher then cannot slide sideways or fore and aft. The same purpose may be served by nailing blocks of wood to the upper surface of the crosspieces, leaving gaps between the blocks to hold the stretcher frame. The Stokes stretcher may be further secured by using slide-bolt locks to hold it firmly in place. However, rope or strap lashings secured to the wood frame may also be used. Using these simple devices, it is impossible for either type of stretcher to slide either fore and aft or sideways, or to bounce out of place. In practice, it was found better to place the notches nearer the sides of the jeep frame than is shown in the photograph. This allows more room for the patient or corpsman who sits between the stretchers. The outside edges of the stretchers thus come almost against the inside of the top frame.

Innumerable minor modifications of this general plan are possible, depending on materials available and personal preferences. Thus, some may wish to bolt the frame in such a position that the anterior end is lower than the rear end, allowing the stretcher to rest in "shock position" during transit. The same, however, may be accomplished by blocking up the rear of the stretcher.

As is shown in the photograph, the jeep can now be used to transport two "stretchers" and two "sitters" in addition to the driver. The stretchers used may be either Stokes or metal pole litter type, or both. One "sitter" sits in the customary seat next to the driver. The other sits on a folded blanket on the lowered back of the rear seat, between the stretchers, his knees under the forward crosspiece.

The advantages of this type of jeep ambulance are as follows:

1. The jeep is not damaged as a jeep when not used as an ambulance. In fact, its usefulness as a utility vehicle is increased. The projecting, floored frame is used as a small pick-up compartment, for personal gear or light freight. The jeep carries the same number of seated occupants as before.

2. No major change in the jeep design is needed. No technical assistance, nor welding, is required in its construction.

3. The over-all width of the jeep is not changed. This is important on narrow roads.

4. The silhouette is kept low, a very practical advantage in combat areas. In actual practice, except in heavy rains, the top is removed. With the driver in a crouched position, the windshield lowered, the entire silhouette is much lower than that of a walking man.

5. Its capacity of two stretchers and two "sitters," in addition to the driver, is maximum. A further increase of capacity, by means of a frame built over the hood of the car, has been tried and is not advised.

6. The jeep top may be used either when the jeep is being used as an ambulance or as a jeep.

7. The original balance of the jeep is maintained, loaded or unloaded. When carrying patients the center of gravity of a prone patient remains over the rear seat.

The final test of any such device must be its performance under actual combat conditions. It is probable that the jeep ambulance frame shown in the photograph is the first to be used in actual combat by our troops. It saw service on Guadalcanal from Nov. 4, 1942. For some time it was the only jeep ambulance available on the island, and served through many weeks of front-line duty, over steep, narrow, rough, and muddy trails impassable to ordinary ambulances, carrying scores of casualties.

Its construction has proved sturdy under this test of use. No repairs were necessary until the jeep, having previously been "wounded" by a sniper, was finally destroyed by a land mine. Even then the frame could still be used. (Fig. 1 shows the frame bolted to another jeep, after this explosion occurred.) Ambulance drivers who drove other models which later became available, including the metal-frame type with higher silhouette, stated they preferred the one described above. Stretcher patients find the riding qualities of any jeep ambulance preferable on a rough road to the large regular Marine ambulances.

A BLACK-OUT FLYPROOF TENT-DUGOUT OPERATING ROOM

The operating room shown in figure 2 proved its usefulness in combat conditions on Guadalcanal, during the early period, before more permanent accommodations were available.

The ideal operating room in such conditions should fulfill the following requirements:

1. It should be readily transportable, and quickly set up.
2. For night work it must be "blackened out."
3. It should prevent the entrance of flies and mosquitoes to surgery.
4. It should offer some protection to personnel and patients against shrapnel fragments.
5. It must have sufficient floor space and headroom for adequate work.
6. Ventilation and light should be adequate.

This modified tent-dugout was devised to fulfill these requirements as nearly as possible, using materials at hand. In actual use it was

found to do so for all practical purposes, and was also used as a night blacked-out admitting and examination room.

As is shown, a regulation Marine pyramidal tent was used. This was suspended by a rope, which was passed through a loop in the center of a second rope, whose ends were tied to neighboring trees. The end of the first rope, after passing through the loop, was secured to the base of one of these trees, and used to raise or lower the tent. By using this rope suspension the center pole of the tent was discarded, allowing more available floor space.

The base of the tent was dug out of a slightly elevated dry site in an afternoon by 10 corpsmen, to a depth of 3 feet. Excavated



2. TENT-DUGOUT OPERATING ROOM.

dirt was thrown on the ground surrounding the tent to form a sloping bank. This accomplished the following purposes:

1. Adequate headroom was obtained, up to the very edge of the tent.

2. Protection of about 5 feet in depth was obtained against bomb fragments. Patients were operated upon lying on a stretcher supported by the field operating table. During surprise air raids, the stretcher was lowered to boxes on the deck, the attendants stooping over to carry on their work, thus obtaining protection against anything but direct hits. Further deepening of the excavation would have avoided even this necessity, but would have required a longer time for excavation, and might have resulted in seepage of water into the tent.

3. Dirt thrown out tended to cause water which drained from the tent roof to run away from the tent.

4. The excavation was carried out over an area 1 foot on all sides narrower than the dimensions of the tent. This allowed a double row of sandbags to be placed inside the tent walls, on the top of the excavation bank. These sandbags also thus formed a continuous shelf around the inside of the tent, upon which to place boxes of supplies and instruments.

To secure ventilation and light, windows were cut on three sides of the tent by slitting the seams of the canvas, then cutting across the bottom to form windows. These were 2 feet high and the width equal to the canvas between three seams. The windows were braced by one vertically sewn 3-inch strip of canvas across the center of each window. These windows were then screened against insects, using the netting from one regular bunk mosquito net; the two sides of the net for two windows, the top of the net for the third. The square end of the net was sewn in place inside and across the vent at the top of the tent.

The flap of canvas formed by cutting out each window was enlarged by sewing a 6-inch strip of canvas to the side and bottom edges of the flap, to form an "overlap," then rolled up and tied; to be lowered for blackout or heavy rain. The entrance was modified in the following manner: A frame, made of tree limbs and braced by ropes, was roofed with a canvas bedding roll protector, one end of which was sewed to the under side of the usual tent doorway. Sides and front of the entrance were screened, by using mosquito nets sewed to this canvas roof and to the sides of the tent doorway. These nets were overlapped across the frame entrance, and weighted at the lower free corners by small stones, to cause them to fall across each other. This entrance was blacked out, when necessary, by two blankets hung from the canvas doorway, inside the entrance.

By using a spray insecticide on the occasional flies which gained entrance, the tent was kept free of insects.

Sides of the tent were tucked under the double row of sandbags placed on top of the excavation inside the tent, and dirt and sandbags banked against the sides from the outside. In doing this the sides of the tent were purposely slanted somewhat inward, "pagoda style," to prevent rain water running down them into the windows. Scrap canvas was also tucked under the sandbags to hang down to the deck of the tent and cover the dirt walls of the excavation. The deck itself was covered with one-half inch of sand and then canvas. This canvas was periodically removed from the tent, cleaned and sunned. Steps cut down inside the entrance were also covered with sand and canvas, and banked with sandbags. Additional light was furnished by battery-operated lights, supplied with the medical company equipment.

During the heavy tropical rains encountered, occasionally some rain water ran down the suspending ropes and into the tent. This could be prevented by using an improvised 6-inch tin "rat guard" on the rope, just above its entrance to the tent, to deflect this rain water. A better method would be to use, if available, a large canvas fly thrown over the horizontal rope, to cover the entire tent. This would also render the operating room cooler.

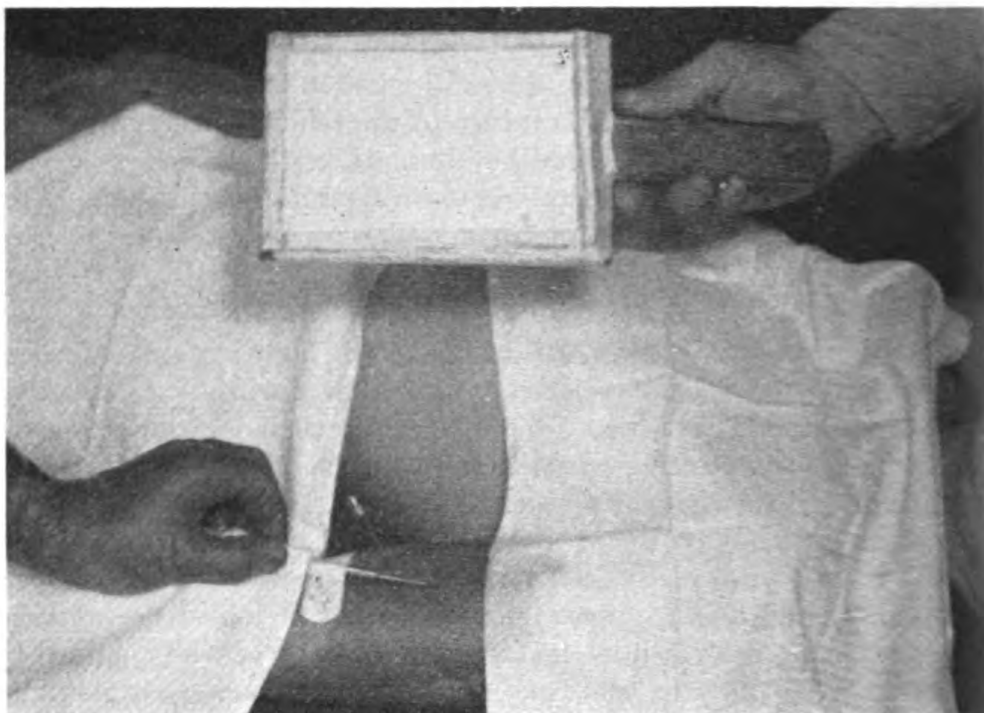
A FIELD METHOD FOR REMOVAL OF FOREIGN BODIES

All surgeons have experienced difficulty in locating small foreign bodies deeply embedded in masses of muscle, even when aided by x-ray. Various methods have been devised to aid in their location, the most recent being an electric "vibrator" probe mechanism, somewhat complicated and expensive. The usual methods of location, by x-ray views in varying planes, by use of mathematical formulae to obtain depth, or by crossed wires placed externally, are often unsatisfactory. Operating in the dark room under fluoroscope has obvious disadvantages. The following described method is not new, but has been modified by the author to apply to field conditions, using the materials available to a medical company. It has proved its value under combat conditions, and, in the hands of several operators, has not resulted in failure. Its simplicity is an asset in the field, and with little practice may be depended upon. With its use, a "vibrator" seems unnecessary.

In figure 3 a patient is seen lying on a wooden table. Beneath the table the "head" of a regular issue field portable x-ray unit is held in a wooden frame. An old cassette has been cut down and mounted on a handled piece of plywood, to make a convenient fluorescing screen as shown.

In actual practice the work is done at night, in order to facilitate accommodation of the eyes and to avoid the need for a large darkroom. This plan was found superior to using a plywood "view box" fitted to the face and to small blanket "darkrooms" placed over the area examined. The area is first x-rayed to get a general idea of the location of the foreign body. This area is then prepared, infiltrated with procaine, draped, and the patient placed on the x-ray table. A spinal needle is then used to locate the foreign body under the screen, controlling the x-ray by foot switch.

In locating the object no attempt should be made to move the needle laterally through the tissues. Location is accomplished by short "jabs" after the skin is passed. During this examination the axis of the needle is kept as far away from a plane vertical to the table as possible; thus "misses" appear as large as possible. Usually, with practice, this probing requires about 30 seconds; then the object may be



3. LOCATION OF FOREIGN BODY

felt grating at the end of the needle, or can be seen moving in the field with the slightest movement of the needle.

If possible the needle is inserted through the original wound of entrance. Thus, the wound tract is opened up in exposing the fragment. As soon as the foreign body has been located by x-ray at the needle point it has been found useful, by the author, to clamp the spinal needle at its emergence from the skin with a sterile hemostat, which is then taped to the skin as shown. It is of course impossible for the needle to wander laterally through the tissues. Such clamping prevents the needle from being forced further in, or withdrawn, when the patient moves.

The patient is then carried to the operating room on a stretcher to minimize movement. The skin and needle are painted with antiseptic, redraped, procaine injected through the spinal needle, and the point of this needle exposed through a suitable incision. The foreign body is found at this point. The main difficulty encountered in the search for a foreign body is that this body is continually pushed aside in the blunt dissection used to locate it. With a needle in place, however, as above described, its point is also pushed aside in the same muscle bundle in which the object searched for lies.

Acknowledgment.—Valuable ideas were obtained from L. T. Sussex, Lt. Comdr. (MC) USNR, on the design for the ambulance; from R. W. Mattson, chief pharmacist's mate, USN, in the use of the field x-ray; from W. W. Hanson, pharmacist's mate, first class, USN, in the design of the operating room; photographs by the U. S. Navy.

SULFONAMIDURIA

A SIMPLE TEST FOR ITS DETECTION

EMIL BOGEN

Lieutenant Commander (MC) U. S. N. R.

An easy, rapid, and reliable test for sulfonamides is of great value. The drugs are never present in the body unless previously taken. Such administration may not be known to the patient or to the medical officer who is to care for him. Inability, ignorance, or culpability may keep the patient from reporting previous use, while the frequent separation of men from their own medical officers and records, especially in the field, makes it impossible to rely upon their histories. Whenever treatment with such a drug is undertaken, it is important to know whether the patient has already taken some, so as to give adequate but not excessive dosage. Flavoring of sulfonamide tablets with peppermint may lessen the danger of overdosage in the unconscious or unknown wounded. More persistent, reliable, sensitive, and specific information can be obtained by a simple qualitative test of the urine.

Sulfonamides may be detected, and their concentration accurately determined, by Marshall's test (1) but this procedure is too elaborate and exacting for routine or field use. Attempts have been made to simplify it, mainly at the expense of precision (2) (3). Other tests have been proposed, depending upon different reactions (4). The simplest of these is the lignin test (5).

The lignin test is extremely quick and easy. A drop of urine is placed on a piece of wood-pulp paper and a drop of hydrochloric acid added. That is all. If as little as 0.01 percent sulfonamide is present, a yellow color appears, which deepens to an orange with higher concentrations. Nothing apt to occur in the urine gives a false positive test.

More than 500 substances have been tested at the Norfolk Naval Hospital to see if they would give a yellow or orange color with wood-pulp paper and hydrochloric acid. Some, as the dyestuffs, had so strong a color themselves as to preclude reading the tests. A few others, as nitric acid, caused yellowing or charring of the paper in concentrated form but gave no such color when diluted. No positive tests were obtained with inorganic substances, alcohols, aldehydes, acids, alkaloids, hormones, vitamins, etc.

A positive reaction was obtained with sulfanilamide, sulfapyridine, sodium sulfapyridine, sulfathiazole, sodium sulfathiazole, sulfadiazine and sulfaguanidine, but with prontosil and neoprontosil it was obscured by the color of the dye itself. A positive test was also obtained with aniline, benzidine, hydrazine, naphthylamine, o-tolidine,

paradimethylamino-benzaldehyde, para-amino-benzoic acid, sulfanilic acid, and the local anesthetics, procaine, benzocaine, and larocaine. None of these, however, have been encountered in urine in concentrations sufficient to give a positive test.

False positive reactions may be obtained similarly with Marshall's, Werner's and other sulfonamide tests (6). Though these substances are not apt to appear in the urine, they have caused serious confusion in connection with blood, spinal fluid, pleural effusions, and other body fluids. This error may be prevented by omitting deep infiltration with procaine when a sulfonamide determination is to be made, or by using cocaine, nupercaine, holocaine, or metycaine, which do not give the test, instead of procaine, pontocaine, benzocaine, or larocaine, which do. The procaine may also be eliminated from the specimen by the use of Mayer's reagent, which precipitates it while leaving the sulfonamide unaffected.

The fact that acidified aniline products or aromatic amides produced a yellow color in contact with wood has been known for a century, but the essential chemical reaction responsible for this change is still obscure. The behavior of sulfonamides is only one instance of this general phenomenon, but fortunately the other substances which may duplicate it do not occur in the urine.

Any product containing wood pulp, such as paper towels, toilet paper, newspaper, cheap magazine paper, rough pencil-writing pads, sawdust, etc., at once presents a positive test, a bright yellow or orange color when touched with a drop of hydrochloric acid and sulfonamide. A similar color is elicited in the absence of wood pulp by adding hydrochloric acid and sulfonamide solution to Ehrlich's reagent, paradimethylamido-benzaldehyde. A yellow, but not the orange tint, could be obtained by adding the sulfonamide in hydrochloric acid to vanillin. No yellow color could be elicited in this manner from more than 500 other substances which were tested at the Norfolk Naval Hospital. Filter paper, linen writing paper or bond typewriter paper, absorbent cotton, cellucotton or Kotex, etc., were uniformly negative.

The active reacting material in fresh fir sawdust giving the yellow color with sulfonamide in hydrochloric acid is completely insoluble in acids, alkalis, alcohols, etc. Accordingly, it cannot be vanillin, Ehrlich's reagent, or other soluble substance. It is probably the insoluble constituent of wood cells, lignin, a cyclic unsaturated compound whose exact formula has not been established, but may be a polymer of coniferyl alcohol (7).

Beginning February 15, 1943, the test has been applied routinely to every urine specimen examined at the Norfolk Naval Hospital. For this purpose a drop of the urine is placed on a piece of paper towel and a drop of 5 percent HCl added from a dropping bottle. A faint yel-

low is read as 1-plus, corresponding to about 0.01 percent sulfonamide, a deep yellow as 2-plus, corresponding to about 0.05 percent sulfonamide, an orange yellow as 3-plus, corresponding to about 0.1 percent sulfonamide, and an orange color at 4-plus, corresponding to 0.5 percent or more of sulfonamide. Centrifuged sediment of the same specimen is examined microscopically for the characteristic prismatic, hexagonal, dumbbell, or fan-shaped crystals of sulfonamides, with only occasional reference to optical rotation or chemical confirmation.

Analysis of the results in the first 3,000 specimens of urine tested revealed positive chemical tests for sulfonamides in about one-eighth of the urines, of which about one-fifth showed sulfonamide crystals, usually acetylated sulfathiazole, microscopically. More than half of the specimens received from the pneumonia service gave positive tests, with more than a third of them showing crystals in the urine, and the negative tests were mainly from new admissions or patients already convalescent, etc. Only a half dozen specimens, of the 3,000 tested, were reported to have sulfa crystals microscopically without a positive chemical test. Unfortunately the specimens were not saved for check in any one of these cases, in order that the exact nature of the crystals seen could be identified, but it seems probable that they were cases of mistaken identity rather than false negative tests.

It is not intended, in this report, to recommend the discontinuance of blood sulfanilamide determinations in controlling the dosage but merely to emphasize the convenience and utility of the simple qualitative test of the urine. In the short time that it has been in use at the Norfolk Naval Hospital it has repeatedly proven to be of practical value. Thus in patients with pneumonia or meningitis, admitted without reliable information regarding previous treatment, negative urine tests have allowed immediate administration of large doses and rapid building up of sulfonamide content of the blood, without waiting for the slower and more laborious initial determination in the blood. Conversely, in such patients admitted in a confused state without record of previous treatment, a positive test has justified delaying such treatment until blood tests could be done, thus avoiding overdosage. Instances have been discovered of patients taking sulfonamides without the knowledge of their medical officers, both as prophylactic against venereal infection and after discontinuance of such treatment for gonorrheal urethritis has been ordered before urethral smears are taken for release. Instances occur where patients had been given sulfonamides but had not been informed of the nature of the treatment, but the clandestine taking of the drug is probably more often encountered. Sometimes the drug may be ordered but not actually taken. In any case, it takes but a minute to test the urine and obtain objective and reliable information, on which to act.

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DETERMINATION OF TURPENTINE IN AIR ¹

MARION T. YATES

Lieutenant Commander (MC) U. S. N.

and

SEYMOUR LEVINSON

Lieutenant, junior grade H-V (S) U. S. N. R.

Turpentine is not a definite chemical compound but is a mixture of terpenes, the principal one being pinene with the formula $C_{10}H_{16}$. Depending upon its method of manufacture and purification, the constituents of various turpentines vary. As a result, its physical properties vary. It is this variable constituency which makes it difficult to develop a specific determination.

As a part of its work, the Laboratory of Industrial Medicine, Navy Yard, Charleston, S. C., investigates the working environment of any employee who complains of symptoms which might be due to his working conditions. Thus, recently when a painter complained of headache and occasional giddiness toward the close of each day's work, turpentine was suspected as the causative agent producing these symptoms. As a result of the investigations made in this case, a method of estimation has been developed which we have found to be quite satisfactory.

The method of turpentine estimation described by Ficklen ² employing a 1-percent solution of vanillin in concentrated hydrochloric acid could not be employed, due to the fact that no vanillin was avail-

¹ Received for publication February 6, 1943.

² Ficklen, J. B.: Manual of Industrial Health Hazards. Service to Industry, 1940. p. 162.

able. Zhitkova* mentions a colorimetric method described by Andreyeff and Graviloff which consists in the absorption of turpentine in concentrated sulfuric acid. The latter method was employed by us; its use is believed justified, as it is easily performed and requires material always present in the simplest of laboratories.

TABLE 1.—Concentrations of known amounts of turpentine and values obtained after standing for a period of 24 hours.*

Tube No.	Concentration in micrograms		Percent error	Tube No.	Concentration in micrograms		Percent error
	0 time	After 24 hours			0 time	After 24 hours	
1.....	50	45	-10.0	11.....	550	525	-4.5
2.....	100	95	-5.0	12.....	600	590	-1.7
3.....	150	140	-6.0	13.....	650	650	0
4.....	200	210	-5.0	14.....	700	705	.7
5.....	250	245	-2.0	15.....	750	750	0
6.....	300	290	-3.3	16.....	800	790	-2.25
7.....	350	360	3.0	17.....	850	855	.57
8.....	400	390	-2.5	18.....	900	890	1.1
9.....	450	455	1.1	19.....	950	960	1.0
10.....	500	510	2.0	20.....	1,000	1,000	0

METHOD OF ESTIMATION

This method depends upon the color produced when air containing turpentine is passed through concentrated sulfuric acid. The color produced appears immediately and is stable for at least 24 hours in concentrations below 1.1 mg. The color varies from a light yellow to a deep orange, depending upon the amount of turpentine present.

REAGENTS (CONCENTRATED SULFURIC ACID)

Standard solution of turpentine.—Turpentine used in preparing the standards should be the same as that which produces the exposure. This is a necessity, as the constituents of various turpentines vary. Standards are prepared as follows: Measure the specific gravity of the turpentine; in our case it was 0.855. Then 1 cc. of this turpentine weighs 0.855 gm. or 855 mg.

Solution "A."—Take 1 cc. of turpentine in a 50-cc. volumetric flask and fill to mark with concentrated sulfuric acid. Mix well. Each cc. of this solution contains 17.1 mg./cc.

Solution "B."—Take 1 cc. of solution "A" in a 50-cc. volumetric flask and fill to mark with concentrated sulfuric acid. Each cc. of this solution contains 0.342 mg./cc.

* Zhitkova, A. S.: Some Methods for the Detection and Estimation of Poisonous Gases and Vapors in the Air. Service to Industry, 1936. p. 178.

* All readings were taken in an Evelyn photoelectric colorimeter using filter No. 520.

Solution "C."—Take 29.2 cc. of solution "B" in a 100-cc. volumetric flask and dilute to mark with concentrated sulfuric acid. Each cc. of this solution contains 0.1 mg./cc. Solution "C" is used in making up standards as illustrated in table 2.

TABLE 2.—Standards used in matching

Tube No.	Concentration		Amount of solution used		Tube No.	Concentration		Amount of solution used	
	Mg.	°	Cc. solution "C"	Cc. concentrated H ₂ SO ₄		Mg.	°	Cc. solution "C"	Cc. concentrated H ₂ SO ₄
Blank...	0	0	0	10	6.....	0.6	600	6	4
1.....	.1	100	1	9	7.....	.7	700	7	3
2.....	.2	200	2	8	8.....	.8	800	8	2
3.....	.3	300	3	7	9.....	.9	900	9	1
4.....	.4	400	4	6	10.....	1.0	1,000	10	0
5.....	.5	500	5	5					

The above standards may be used to match the unknown or they may be placed in an Evelyn photoelectric colorimeter, using a No. 520 filter, plotting the galvanometer readings against the concentration in the form of a graph. The latter method was used by us.

Collection of sample.—Pass air through two 125-cc. fritted glass bubblers, each containing 50 cc. of concentrated sulfuric acid, at a rate of 1.0 liter per minute for 10 minutes. With extremely low concentrations, it may be necessary to sample for a longer period of time or to increase the rate at which the sample is obtained. It has been our experience that the rate of sampling (actual runs between 0.1 liter per minute to 1 liter per minute) has no appreciable effect upon the amount of turpentine carried over into the second bubbler (see table 3). It has been our practice to sample air until a definite yellow color appears in the bubblers, continuing a sample until an even number of minutes has elapsed in the run to simplify calculations.

TABLE 3.—Sampling rate

Parts per million	Micrograms caught by bubbler		Sampling rate liter/minute	Parts per million	Micrograms caught by bubbler		Sampling rate liter/minute
	First	Second			First	Second	
37.0.....	330	75	0.1	37.0.....	330	75	0.5
101.0.....	660	75	.3	185.0.....	3,300	75	.8
38.0.....	365	75	.4	7.5.....	200	50	1.0

Analytical procedure.—10 cc. of colored solution is transferred to colorimeter tubes from each bubbler. A colorimeter reading is obtained on the Evelyn photoelectric colorimeter, using an Evelyn No. 520 filter. Opposite colorimeter reading on graph (prepared from a set of known standards) the turpentine present in the solution is read

in micrograms. When a colorimeter is not available, the unknown samples may be matched against standards made up as shown in table 2.

Calculation of PPM turpentine in air:

$$\text{PPM} = \frac{0.18 \times \text{micrograms } (\gamma)}{\text{volume (liters)}}$$

Micrograms=sum of micrograms in colorimeter tubes 1 and 2, multiplied by 5 (since an aliquot (10 cc.) of the total (50 cc.) was taken originally).

Volume=rate of sampling in liters \times number of minutes in run.

Derivation of formula:

$$\text{PPM} = \frac{\text{mols. of gas}}{\text{mols. of air}} \times 10^6$$

$$\text{mols. of air} = \frac{\text{weight in grams}}{\text{molecular weight}}$$

$$\text{mols. of air} = \frac{\text{volume (liters)}}{24.5}$$

Molecular weight turpentine=134.52

$$1 \text{ microgram} = \frac{1}{1,000,000} \text{ gram}$$

$$\text{PPM} = \frac{\frac{\text{microgram}}{1,000,000} \times 10^6}{\frac{134.52}{\text{Volume (liters)}} \times 24.5}$$

$$\text{PPM} = \frac{24.5}{134.52} \times \frac{\gamma}{V} \times 10^{-6} \times 10^6$$

$$\text{PPM} = \frac{0.18 \times \text{microgram } (\gamma)}{\text{volume (liters)}}$$

Discussion.—In dusty atmospheres a dust filter should be attached to the air intake end of the bubblers. When this test is used it must be remembered that the method is not specific for turpentine. Other terpenes give a coloration. A list of compounds studied with their color reaction is reproduced in table 4.

TABLE 4.—Color reactions of various compounds

Reagent plus concentrated H ₂ SO ₄	Color reaction	Reagent plus concentrated H ₂ SO ₄	Color reaction
Acetone.....	None.	Diethylamine.....	Do.
Alcohol, methyl.....	Do.	Ether.....	Light pink.
Alcohol, ethyl.....	Do.	Gasoline.....	Clear orange-brown.
Alcohol, isopropyl.....	Clear yellow.	Methyl ethyl ketone.....	Light yellow.
Alcohol, caprylic.....	Light orange.	Nitrobenzene.....	Do.
Benzene.....	None.	Phenol.....	Light amber.
Carbon disulfide.....	Do.	Triethanolamine.....	None.
Carbon tetrachloride.....	Do.	Xylol.....	Do.
Chloroform.....	Do.		

CONCLUSIONS

We do not claim that the method employing the absorption of turpentine in concentrated sulfuric acid to be original with us, as it has been previously described by Andreyeff and Graviloff.

Not having access to the original article, the procedure employed here is our own. Checking this method against turpentine of known concentrations, we are convinced it is accurate with the procedure employed here.

It has been found very useful by us and is reliable where there are no known interfering agents present.

AN AID TO INTRAVENOUS TECHNIC¹

RICHARD S. SILVIS

Lieutenant Commander (MC) U. S. N.

During the past decade the intravenous administration of fluids has assumed an ever increasing importance. War has created special situations, frequently necessitating the simultaneous administration of fluids to a large number of cases. This is true particularly in the case of modern naval warfare, in which the predominant injury following action is the massive burn. The rapidity with which the intravenous administration of fluid can be initiated in a large number of seriously burned cases has a direct influence on the mortality rate. Therefore, any mechanical aid to intravenous technic that would speed up the administration of fluids is worthy of consideration.

DESCRIPTION OF INSTRUMENT

The Edwards' vein seeker² is a simple device that can be manufactured in quantity with materials that are always available on board ship (fig. 1). Any piece of glass tubing may be used for the sight glass; however, the glass tube that is furnished with Vacoliter sets is ideal. This tube is the correct length, and the grooves around its ends permit wiring the rubber tubing to it more tightly. It is necessary to wire both the rubber teat and the rubber tube to the glass tube, and to wire the rubber tube to the needle, as the apparatus must be airtight. Several of these vein seekers can be made up, sterilized, and kept ready for use at all times. It is advantageous to place one of them in each sterile intravenous set.

TECHNIC

The vein seeker is filled completely with 2½ percent sodium citrate solution. The hub of the needle is held between the thumb and fore-

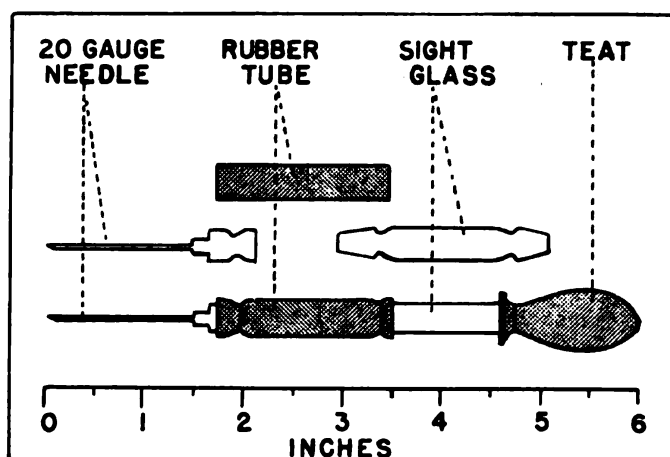
¹ Received for publication January 30, 1943.

² Bailey, H.: *Emergency Surgery*, 4th edition. Williams & Wilkins Co. P. 763.

finger, while the teat is compressed against the hypothenar eminence by the little finger. The compressed teat is therefore partly empty, but the rest of the instrument is filled completely with citrate solution. The needle is inserted into the skin over the vein, and as soon as the lumen is beneath the skin, the pressure on the teat is released. It is preferable to have the bevel of the needle down, as the lumen is completely beneath the skin before the tip of the needle enters the vein if this technic is used. The teat remains collapsed until the vein is entered, and then the negative pressure draws blood back to the sight glass. The vein seeker is taped in position. The outside of the rubber tubing is sterilized with alcohol, and a needle is inserted through this tubing to administer the fluid.

After the desired amount of fluid has been administered, the needle is withdrawn from the rubber tubing, and the vein seeker is left in situ.

The citrate solution will prevent occlusion of the needle by clotted blood. Repeated intravenous administrations may be given later without necessitating additional venipuncture. In case the instrument is to be left in situ for several days, a small piece of cotton soaked in tincture of merthiolate should be taped over the point where the needle enters the skin.



1. THE EDWARDS' VEIN SEEKER.

DISADVANTAGES

The only disadvantage of the Edwards' vein seeker is that a delay of 30 seconds to a minute is caused while the instrument is being filled with sterile citrate solution. This is not a real disadvantage, however, for several minutes are saved in the complete procedure, particularly in the case of multiple intravenous administrations of fluid.

ADVANTAGES

Because of the constant negative pressure, the locating of veins is rendered much easier. This is a distinct advantage in a case of marked shock with collapsed veins, and in the case of a patient with very small deep veins.

Venipuncture is rendered so comparatively easy with this instrument that it is possible to train several corpsmen to use it. This not only enables more intravenous administrations to be started without delay, but would be of great value in case the medical officers were casualties.

In case the medical officer desires to do all of the venipunctures himself, he need only go from patient to patient, insert the vein seeker and tape it in place, and allow the hospital corpsmen to finish the procedure of setting up the remainder of the intravenous apparatus.

Repeated administrations of fluid can be given to one patient with only one venipuncture. With the use of this instrument, the all too frequently seen patient with multiple needle puncture holes on both arms would become a relic of the past.

In certain patients, the only available vein runs obliquely across the arm, and it is difficult to tape the usual apparatus in position so that the needle will remain in the vein. The vein seeker, because of its flexibility, may be adapted to the curve of the arm in these cases, and it is easy to maintain the needle in position within the vein.

Whole blood, blood plasma, or any solution suitable for intravenous use may be administered through this instrument.

SINGLE UNIT EMERGENCY PLASMA PROCURING AND DONOR APPARATUS ¹

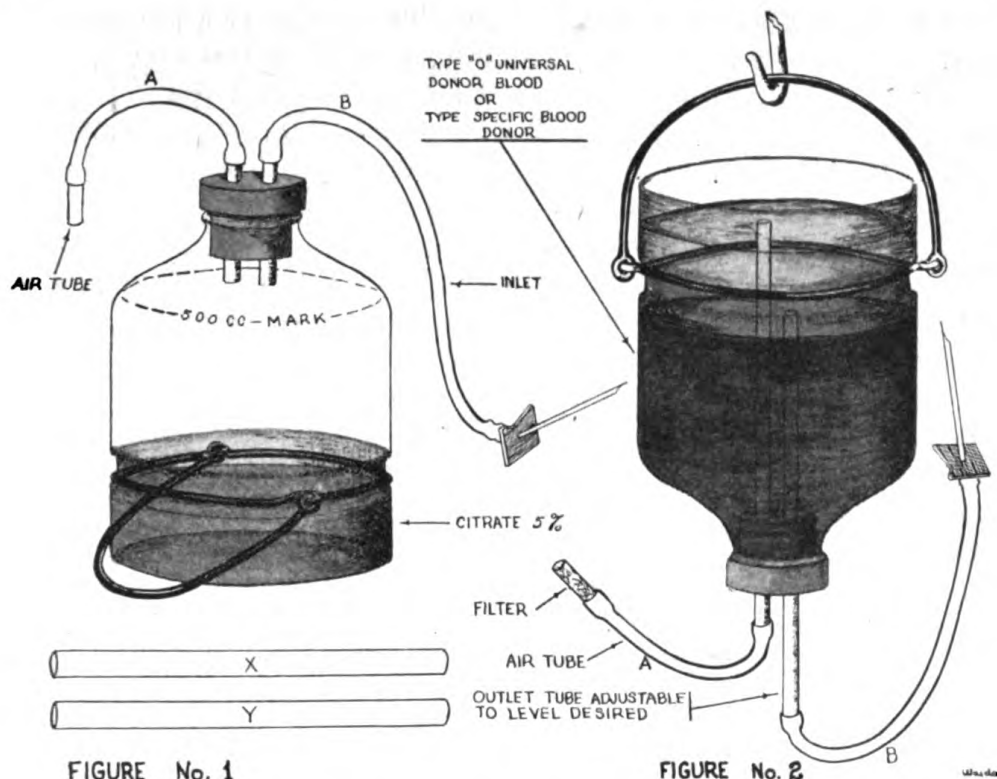
HERBERT R. BROWN, JR.
Lieutenant (MC) U. S. N. R.

This type apparatus is suggested for employment after supplies of plasma have given out, and at far distant bases where replacement is impossible. This unit can, of course, be used for transfusion. Its value lies in its simplicity, being a single unit with very few parts necessary for its operation.

Figure 1 shows the donor apparatus which is taken from the type of standard Red Cross donor bottle, and also the transfusion apparatus used in the Navy. The 5 percent citrate is advisable as an extra guard against clotting. Blood is taken in this flask to the 500-cc. mark (or as much as desired) from a type "O" donor. If feasible, a type-specific donor may be used. Packed sterile with the set, and also in multiple replacements, are tubes X and Y.

After the blood has been obtained, take the sterile tubes X and Y, and after cleansing the top of the cork with alcohol, remove tubes and insert X and Y to the bottom of the flask. Then invert the flask as shown in figure 2. Let this hang for several hours, preferably

¹ Received for publication January 4, 1943.



overnight, and under refrigerated conditions. Tubes A and B, of course, are clamped. When ready to give the blood or plasma, tube Y is drawn out to the level where the cells have settled. About 30 to 40 percent of the total volume is fairly clear plasma. Fifty percent, or even a little better, may be used; if some of the suspended cells do get through it will be of little consequence, since type "O"—universal donor—cells are being used.

A DERMATOME FOR CUTTING SMALL SKIN GRAFTS¹

GEORGE V. WEBSTER
Lieutenant (MC) U. S. N. R.

In December 1938 Padgett (1) first presented his new method of cutting skin grafts of any desired thickness by means of an instrument called a "dermatome." This instrument was essentially (1) a drum which was made to adhere to the skin of the donor site by means of adhesive cement, thus lifting the skin for cutting, and (2) a knife, so arranged as to travel concentrically about the drum, cutting the graft. This knife was held a fixed distance from the drum by set screws of micrometer accuracy, so that precision-thickness grafts could be cut.

¹ Received for publication January 30, 1943.

In developing this instrument Padgett finally achieved a sure method of cutting skin grafts, a search for which had extended over several decades. (Koch (2) has written a scholarly review of the history of skin grafting which is well worth rereading.) All sorts of ingenious devices for holding the skin taut, gaging depth, etc., were introduced hopefully, only to find they were not very practical.

The suction box of Blair and Brown (3) was a great advance, and grafts, larger than any which had been previously possible, were cut with ease, once one had acquired the necessary skill. The long record of their success is well known, and massive skin grafts became common practice. The teachings of their clinic form a solid foundation for all who do plastic surgery. Padgett (4), however, states that in his experience, he “* * * was never able to cut the graft (i. e., the split-thickness graft prescribed by Blair and Brown) without considerable variation as to thickness and size.” This is true in the experience of most operators, and even those most skilled in the cutting of grafts with the Blair-Brown knife and suction apparatus must admit that their proficiency has been obtained only by long practice and development of the technic.

THE LARGE DERMATOME

With the advent of the dermatome, sizeable grafts of sufficient thickness and smooth, even character could be obtained easily by many surgeons who had not mastered the “freehand” technic. Skill is certainly required in the use of the dermatome, and it takes much practice to use it with surety and finesse. Nevertheless, its use is more easily mastered, in the majority of cases, than the suction box and free-knife technic.

It soon became apparent, also, that the quality of the grafts and the character and texture of the newly placed skin is oftentimes superior to that of the other less even grafts. In addition, many donor sites can be used with the dermatome which could be used with difficulty, if at all, using the suction box and knife. Skin from a thin chest wall or a flank or across a lower abdomen can be used as easily as the thigh, and the rapidity of healing of such a donor site is greater than the thigh for the reason that it is less dependent, avoiding lymph and venous stasis. It is also notable that the patients may be allowed up earlier and without the hemorrhagic blotching of the donor site so common when the thigh is used.

It is for these reasons that the new instrument has become popular and is being used throughout this country and abroad, and has been included in the operating room equipment of many of the base hospitals in the armed forces. Earlier grafting of burns and other injuries is now being done with increasing frequency, and the contribution of

Padgett and his associates in presenting this instrument to the profession is very great indeed. Countless deformities may be prevented or alleviated by its use.

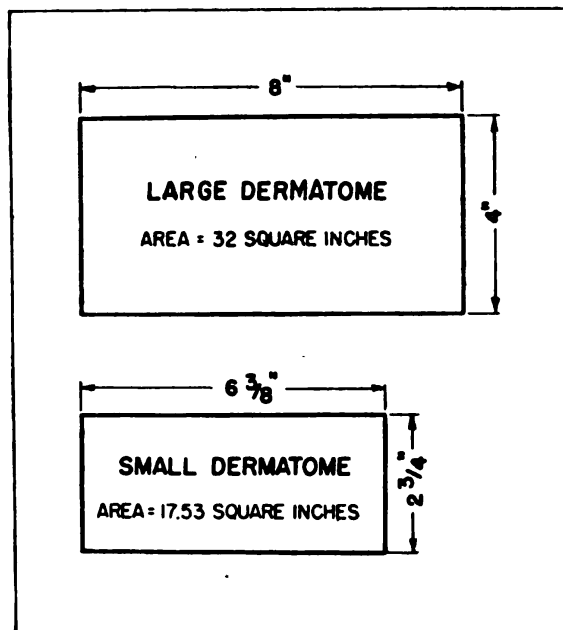
The surface area which can be taken with the large dermatome (fig. 1) is 8 inches by 4 inches, or 32 square inches. Grafts of this size, or several of them, are needed to cover a large burned or scarred area. Some burn scars require enormous amounts of grafted skin. Brown and McDowell (5) report that "up to 600 square inches have been done in one patient, and 100 to 200 square inches at a time are possible. To do this, huge grafts are necessary and they have been taken as large as 36 inches by 4 inches." A graft of this size is obviously much larger than can be cut with the large dermatome, and yet the number of cases in which so large a single graft is necessary are relatively few in comparison with all cases in which skin-grafting is used. It should also be added that the number of surgeons who can cut a graft of these proportions is decidedly limited.

THE SMALLER DERMATOME

There is a group of cases in which relatively small grafts are needed. Examples of these are:

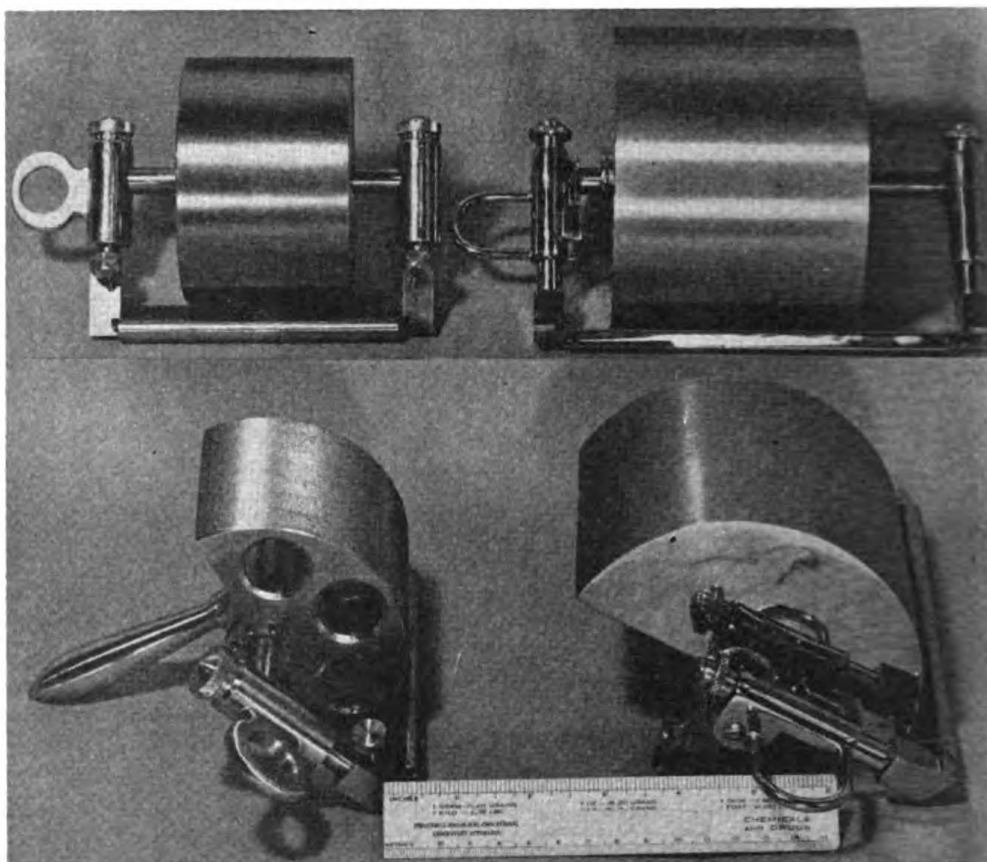
1. Excisions of superficial tumors.
2. Burns with fairly small areas of third degree burn which need grafting.
3. Small scar contractures, especially about the hands and fingers, including Dupuytren's contracture.
4. Clean traumatic wounds with skin loss.
5. To hasten epithelization of small clean, granulating wounds and ulcers everywhere.

Small freehand grafts can be used to cover these defects, but the even thickness and other qualities mentioned above for the machine-cut graft often make this type of skin more desirable. In addition, the use of a suction box and knife are not always possible, especially where such a procedure is to be done on the ward or in the patient's room, treatment room, or small sickbay.



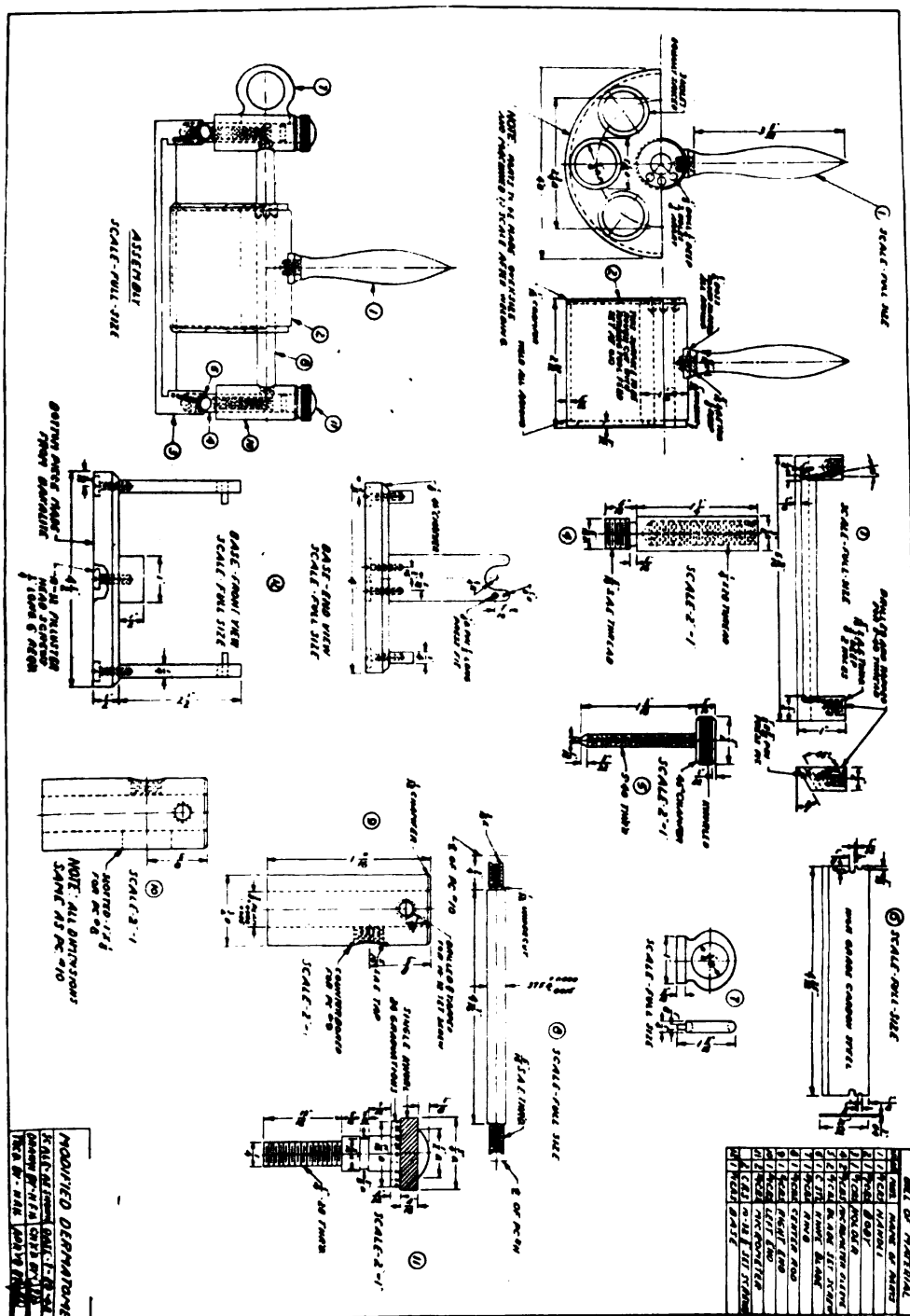
1. COMPARATIVE SURFACE AREAS OF LARGE AND SMALL DERMATOSES.

To use the large dermatome in these cases requires a more or less major procedure, usually in the operating room. An area, the size of the graft to be taken, is painted with the adhesive cement and the dermatome used in the usual way. The large dermatome is just a bit clumsy and oversize for many of these smaller grafts and it has been found that many areas which should be grafted are left uncovered or tissues pulled too tight. It is because of these difficulties that the smaller dermatome has been developed, not to supplant the very efficient instrument of Padgett but merely to supplement its usefulness.



2. FRONT AND SIDE VIEWS OF A STANDARD LARGE DERMATOME COMPARED WITH THE SMALLER DERMATOME DESCRIBED IN THIS ARTICLE. NOTE THE VERTICAL HANDLE FOR GRASPING THE SMALLER DRUM, AND THE RELATIVELY SHORTER BLADE AND CUTTING ARM.

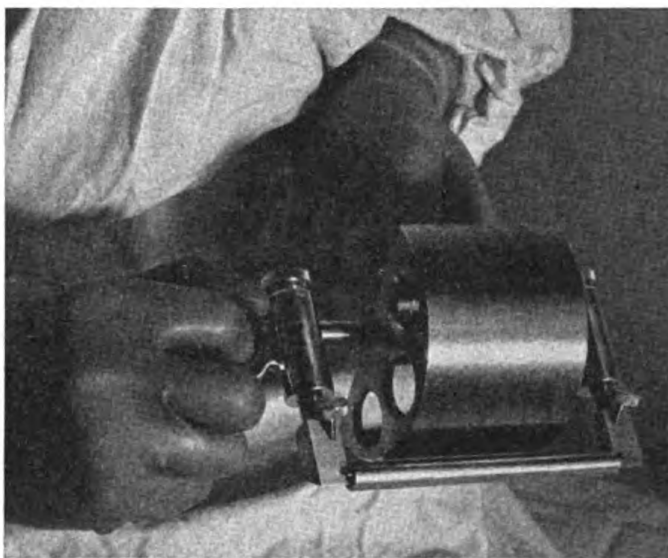
In planning a smaller dermatome, it was decided to use a drum $2\frac{3}{4}$ inches wide, with a radius of 2 inches and with a surface area of 17.53 inches. This gives an instrument which is considerably smaller than the standard model (fig. 2). Details of its construction are well shown in figure 3. The grasping mechanism for the operator's left hand consists of a vertical grip with the thumb and forefinger nearest the drum (fig. 4). In this position, complete rotation of the drum is possible.



3. DETAILS OF CONSTRUCTION OF THE SMALLER DERMATOME.

Such an instrument is very useful. It can be used in the operating room when a small graft is needed, but it is especially useful in the emergency room, the treatment room, or at the patient's own bedside. When the small dermatome is autoclaved and wrapped in a sterile towel, the field can be made ready in a few minutes, painted with adhesive cement and the graft cut. Sterile vaseline gauze and pressure dressings to the donor site complete the operation, and the graft

can be applied at once. Local anesthesia, blocking the donor site, is very satisfactory.



4. METHOD OF GRASPING SMALLER DERMATOME. FROM THIS POSITION, A FULL ARC IS POSSIBLE. (AT THE START OF CUTTING THE GRAFT, THE HANDLE LIES A LITTLE MORE DEEPLY BETWEEN THE THUMB AND FOREFINGER OF THE LEFT HAND.)

SUMMARY

1. The usefulness of the Padgett dermatome in cutting skin grafts is indicated.

2. There are a number of instances in which small areas of skin are needed and for which the qualities of a dermatome graft are desirable.

3. These can be taken with the large dermatome, but there are certain advantages in a smaller instrument, namely, (*a*) its use in the treatment room or at the bedside without setting-up for a major procedure, (*b*) its ease and convenience in handling, when only small grafts are needed.

4. A smaller instrument is described.

NOTE.—The author would like to express appreciation to Ensign J. E. Dawson, U. S. N., for technical assistance.

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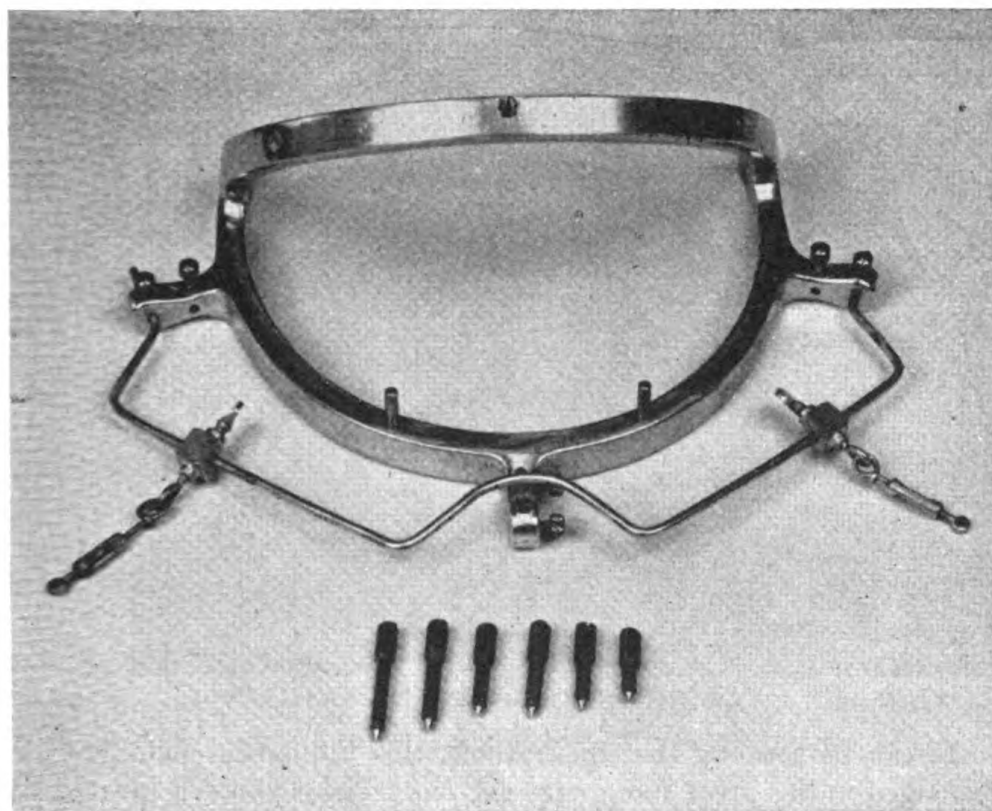
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APPLIANCES AND ATTACHMENTS FOR TREATMENT OF UPPER JAW FRACTURES¹

MERRITT J. CRAWFORD

Lieutenant Commander (DC) U. S. N.

Lieutenant Commander F. A. Bloom, Medical Corps, United States Naval Reserve, and I have designed a headband specifically for use in the treatment of upper jaw fractures but which can be used in certain



1. WEIGHT OF APPLIANCE, 10½ OZ. THE TURNBUCKLES AND ADJUSTMENTS ATTACHED TO THIS BAND WERE DEVELOPED BY DR. JOHN B. ERICH, MAYO CLINIC, ROCHESTER, MINN.

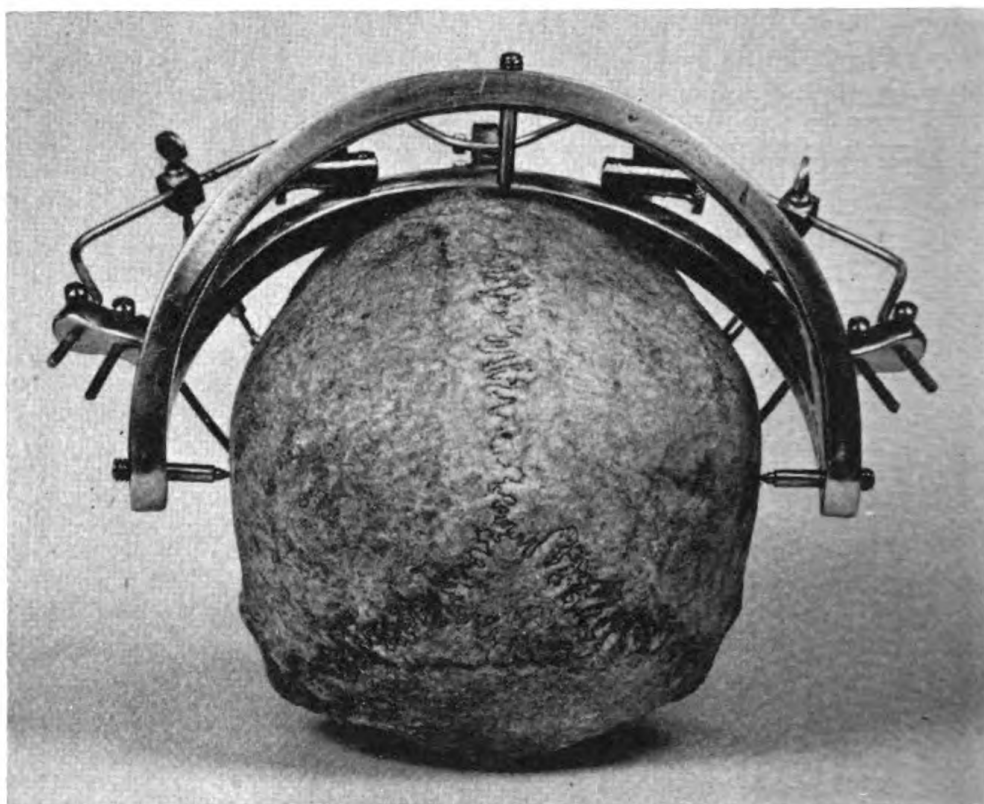
instances for fractures of the mandible. Various existing appliances can be readily attached to this headband.

This appliance was cast from a fragment of a propeller blade. It was cast into a headband that encircles the head from below the

¹ Received for publication February 25, 1943.

parietal boss on one side anteriorly to the same position on the opposite side, with a connecting band which passes over the post-frontal area. This band is cast of sufficient size to take care of any type head. The only adjustment necessary for use in different sized heads is in the selection of different length pins (fig. 1). These pins are so arranged that they fall within the hair line. Even with people partially bald, the pins may still be within the hair line.

In placing the appliance on the head, it is not necessary to make incisions for these pins. Just hold the appliance in the position as illustrated in figure 2, and screw the pins through the scalp until they barely engage the cortex of the skull.



2. DEMONSTRATING PIN FIXATION.

As can be seen by the illustrations, this appliance could not be dislodged unless great force were exerted. There is not a great deal of movement to the usual plaster headcap on people who have a pronounced occipital protuberance, but in round-headed individuals the plaster headcap is a very difficult problem.

It is very discouraging to pull the bones of the face up into position, only to find the next morning that the headcap has slipped forward and new traction has to be applied. The scalp is very movable and it is impossible to place a nonstationary object on a movable surface and have it remain fixed. This new appliance being stationary, ordi-

nary head movement cannot possibly change its position. With the plaster headcap on bedfast patients, head movement becomes quite a liability, but a patient may rest his head on a pillow comfortably and not disturb this appliance.

In most cases of facial injury, scalp wounds, and lacerations in the frontal area are present, which necessitates waiting 10 days to 2 weeks before a plaster headcap can be applied, after which time the bones of the face have already united. With this appliance cases having scalp wounds and lacerations can be very readily taken care of, and it is not necessary to wait for the wounds to heal before putting on the appliance.

Another advantage is the absence of edema of the scalp, infection, and loss of hair which frequently occurs in patients on whom the plaster headcap has been allowed to remain for any length of time. This condition is particularly true in tropical and semitropical climates as healing is retarded due to the necessity of removing the plaster.

Considerable time, effort, and expense are involved in putting on a plaster cap with the necessary traction appliances incorporated, while this appliance can be easily put on in about 5 minutes' time. Not only is it simple to apply, but check x-rays may be secured, as the appliance offers very little interference.

In the case illustrated in figure 3, this appliance was used and allowed to remain until the fracture had united, a period of 1 month. During this time the patient suffered little discomfort, and 2 days after the appliance was removed the pinholes had completely granulated over.

There is always danger of infection where the three pins break the epithelium of the scalp. A drop or two of serum around the pins may appear at times but no serious involvement takes place. Of course if an ambulatory patient should fall and strike his head where the appliance is attached it could be quite serious. To sum up the advantages of this appliance; movement is eliminated; cranial traction may be readily applied to bedfast patients; it may be applied over scalp wounds; edema, infection, and loss of hair disappear; it is easy to apply, may be checked by x-ray, and, last but not least, the patient suffers little or no discomfort. The advantages outweigh the two very problematical disadvantages of possible infection around the pins, or of an ambulatory patient falling.

As many cases of maxillary fracture are in shock and have cerebral involvement, it is sometimes best to temporize. However, if the maxilla is quite movable when the patient breathes or moves his lip, a Kingsley impression tray with a little modeling compound may be placed over the upper teeth and traction applied to an aviator's helmet



3. THIS WAS IN PLACE ONE MONTH WITHOUT DISCOMFORT.

or bandage. If the patient has had any cerebral involvement or if the nasal bones are driven back in the ethmoids, it is advisable to wait from 10 to 14 days before there is any attempt to move the maxilla into position.

The attachment that has worked best in my hands, when it can be used, is the expansion arch. Place orthodontic bands on the upper first molars and wire the expansion arch to the teeth. When upward traction is applied the orthodontic band will keep the attachment from pressing upward on the gingiva, which sometimes causes infection and slough of these tissues. However, it is often impossible to get these bands in place, particularly if there is a full complement of teeth, or if the contacts are tight and associated with a badly fractured maxilla.

If this cannot be used, any arch bar will suffice. The attachment we are using mostly is a 12-gage, half-round german silver wire. As a matter of fact, this is the only material I have been able to use in close-bite cases, complicated with short crowned teeth.

If any type of arch bar is used, necessary upward traction will pull the bar into the tissues as noted in the above paragraph. However, when intermaxillary wiring is done, this can be taken care of by placing intermaxillary wires opposite the point where upward traction is to be applied.

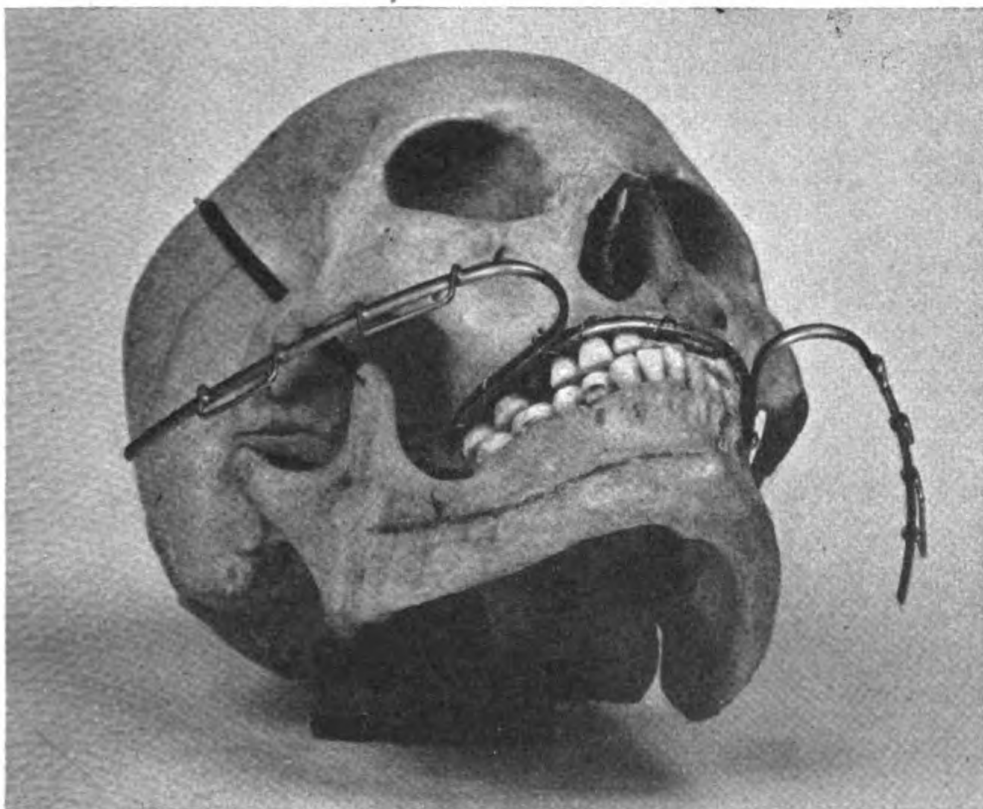
The sectional acrylic on silver splint is very desirable, but most of the time the maxilla is so movable and has been displaced to such an extent that it does not lend itself to the taking of impressions.

In edentulous cases, a full upper acrylic base with either the Kingsley traction or wires through the cheek works well.

There are four ways of applying traction. First, after intermaxillary wiring and occlusion have been established, several thicknesses of rubber dam are placed under the lower jaw and secured to the headcap or bandage.

Secondly, if a laboratory is available and impressions can be secured, the Kingsley sectional splint, a sectional acrylic splint with arms attached, is splendid.

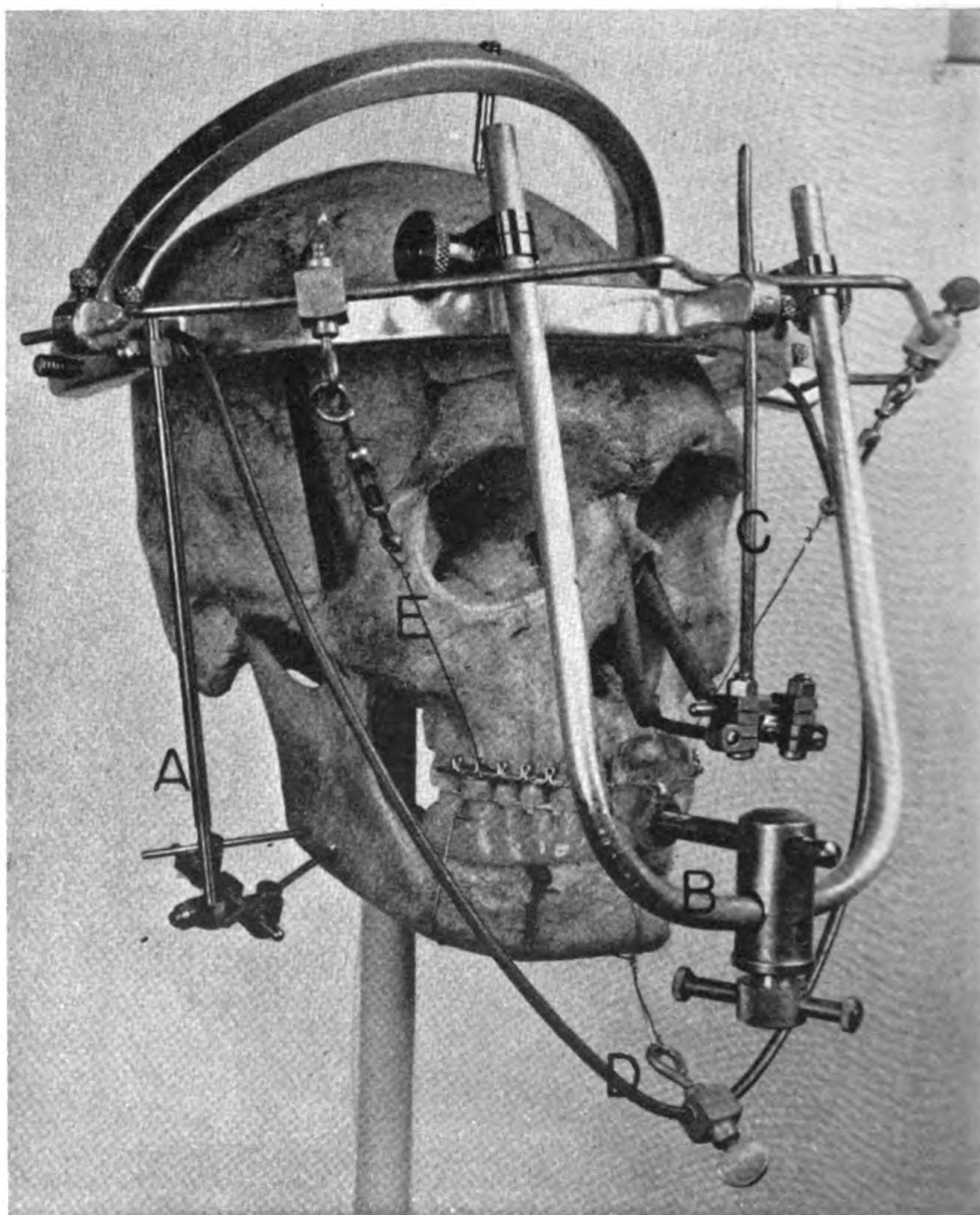
In the third place, I find that the Kingsley arch bar works to a good advantage as in figure 4, except for the bulky arch bar that is necessary for a leverage attachment.



4. KINGSLEY ARCH BAR.

The fourth method of applying traction by means of wires through the cheek as illustrated is the method of choice that I would recommend.

After the maxilla is in position, wires are inserted through the cheek, and intermaxillary wiring and occlusion is established. Upper traction is then applied, as in figure 3, care being taken to adjust the pull with the turnbuckles so that the wires do not cut the cheek. If the mandible has not been broken it is fairly simple, for the patient will complain of pain in the mandibular joint if the maxilla is pulled up too far, so that by slacking off a bit with the turnbuckles, until



5. VARIOUS AUXILIARY ATTACHMENTS WHICH CAN BE USED. SEE TEXT.

the pain disappears, the maxilla should be in excellent position. However, if there are condylar fractures or fractures at the angle of the mandible, it is purely guesswork unless good x-rays can be secured. On the other hand, if there happens to be a transverse fracture through the orbit and the eyeball has dropped down, keep applying traction until the patient's diplopia is corrected. If edema has disappeared, orbital margins may be palpated. When it is determined that the maxilla is up in position, the appliance should be secured and allowed to remain in this position for 3 weeks to a month. If the mandible has not been involved, intermaxillary wiring may be removed in 10 days and the patient allowed a soft diet. Many clinicians tell us that it takes from 6 weeks to 2 months for union of maxillary fractures, but in such cases I do not believe that they have been brought up into position, and loose fibrous tissue has formed between the fracture ends. The maxilla has a good blood supply and is very cancellous, and if the bones are brought up into good position union will usually take place very quickly.

Our headband has been carefully designed so that any of the existing appliances or tractions may be attached as noted in figure 5. Any one or all of these appliances or tractions may be secured to the headband very easily and simply.

Figure 5-A may be used to control the unruly posterior edentulous portion of the mandible by means of the Roger Anderson splint anchored to the band. In figure 5-B the headband lends itself to the maxillary appliance that was developed by Drs. Ralph and Taylor of the Dental Corps, United States Navy. This appliance would be a valuable aid in the treatment of a case where the maxilla was fractured in such a way that it was inclined to tip or rotate after it was pulled into position, complicated by fracture of both rami or condyles of the mandible. Figure 5-C demonstrates how any type of appliance for fracture of the nasal bones may be attached to the anterior horn of the headband. In figure 5-D wires may be attached to the headband and traction applied at any point desired. In figure 5-E traction is being applied by means of wires through the cheeks. These turn-buckles and adjustments were adapted from an appliance developed by Dr. John Erich of the Mayo Clinic, Rochester, Minn.

This method of traction, Figure 5-E, used for the reduction of maxillary fractures, works better in my hands than any other and has been the answer to many of my problems.

COTTON SUTURES ¹

JOSEPH W. KIMBROUGH

Commander (MC) U. S. N.

During the past few years numerous articles have appeared on the use of cotton as suture material. These have been based on large numbers of cases and have been largely favorable to the use of this material.

It is not the purpose of this paper to elaborate on the conclusions reached in the many excellent articles which have been written on this subject. However one or two practical points, none of which are original, may be worthwhile mentioning.

The first is that a certain amount of shrinkage occurs when cotton suture material is autoclaved. As a result rupture of some of the fibers, with resultant weakening of the suture, occurs if the material is wound on a glass, metal or wooden spool. It is best to use a piece of gauze for this purpose.

In regard to the absorption time of catgut the only thing which can be definitely stated is that plain gut is absorbed more rapidly than chromic gut. Such terms as "10-day" and "20-day" catgut seem to be entirely meaningless, as there is positive evidence that in some individuals the absorption time is less than half the stated time.

The subjects of possible infection and local tissue reaction from catgut will be passed over.

The purpose of this article is to present the case for cotton sutures aboard ship under wartime conditions. There are two main ways in which such conditions differ from hospital practice. In the first place sterile technic aboard ship is generally considered inferior to that possible in hospitals. This is a matter of opinion. Secondly, due to transportation difficulties, the area in which the ship is operating, or the sudden influx of a large number of casualties, there may be no catgut available. Cotton thread can practically always be obtained from small stores or the sailmaker in at least two sizes.

The following operative procedures in which cotton was utilized for sutures and ligatures have been done aboard ship during the past year:

Hernia repair.....	12
Plastic repair.....	2
Excision of bursa.....	1
Appendectomy.....	15
Thyroglossal cyst.....	1
Excision of oral tumor, premalignant.....	1
Amputations.....	2
Varicocelectomy.....	1

¹ Received for publication February 3, 1948.

Of the hernias one was ventral and the remainder inguinal. Of the latter, one was sliding and three were direct. The oldest patient was 42 years old. Seven of these 12 cases have been under observation for 6 months or longer. There has been no evidence of weakening or recurrence in any of these 12 cases. One case was traumatic following a bomb explosion.

In the appendectomies cotton was used for tying the stump of the appendix as well as for ligatures and closure. The stump was not inverted. A McBurney incision was used in 4 cases and a Battle approach in 11.

Pathological examination showed the oral tumor to be premalignant. Here healing was rapid and firm. X-ray treatment was given later with apparently excellent results.

In all these cases either local, spinal, or regional block anesthesia was used.

The only infection noted in this series occurred about one skin suture. This caused no trouble and healed rapidly. In this case a few acne pustules were present about the abdomen prior to operation.

In no case did the postoperative rise in temperature reach 101° F., and in only a few did it reach 100° F. These postoperative elevations seemed definitely lower and of shorter duration than when catgut is used. Minimum scar formation was observed in all cases.

In addition to the cases reported cotton has been used for ligature and closure in an almost innumerable number of wounds and lacerations. Here it has appeared to be second to none for skin closure. It has seemed to cause practically no local reaction and there are no stiff ends to catch when gauze dressings are removed. Knots remain tight and are easily tied.

In conclusion it may be said that in every way the use of cotton suture material aboard ship under wartime conditions seems to be both practical and desirable.

X-RAY FILM STORAGE ¹

A. PORTER S. SWEET

Lieutenant Commander (DC) U. S. N. R.

In order to secure radiographs of satisfactory quality the naval radiodontist must, insofar as he is able, prevent pre-exposure fog. This decidedly detrimental all-over haze lowers the contrast of the radiograph and thus makes interpretation much more difficult. It is caused both by film age (beyond expiration date) and by improper storage.

¹ Received for publication February 11, 1943.

The age factor cannot be controlled, for it is often expedient to keep on hand a larger quantity of film than would be necessary if a supply depot were readily available.

Storage conditions, however, can often be improved to such an extent that considerably less fogging will occur, and the resultant radiographs will thus be decidedly improved in quality.

X-ray film will deteriorate if exposed during storage to heat, humidity, extraneous x-radiation, or chemical fumes. All of these factors should be considered when choosing storage space for reserve x-ray film.



1. (A) MANDIBULAR MOLAR AREA TAKEN WITH FRESH, UNFOGGED FILM. NOTICE THE SATISFACTORY CONTRAST AND THE LONG RANGE OF DENSITIES SHOWN IN THIS RADIOGRAPH. (B) THE SAME MANDIBULAR MOLAR AREA WITH FILM THAT HAS BEEN FOGGED BY IMPROPER STORAGE. NOTICE THE LACK OF CONTRAST AND FLATNESS OF THE IMAGE. THE EFFECT OF FOGGING IS ESPECIALLY APPARENT IN THE LARGE RADIOPAQUE MASS AT THE APICES OF THE MOLARS.

Heat.—Especially difficult to overcome in summer and in the tropics. It is wise always to keep surplus film in a refrigerator. But on removal from the refrigerator, it is also important that the film be permitted to *remain at room temperature at least overnight* before opening the package, for, should the change in temperature be too sudden, there is a possibility that moisture would condense on the film emulsion and cause difficulty.

Humidity.—Also difficult to counteract, especially at sea and in the tropics. The periapical dental x-ray film comes wrapped in heavy paper, 12 boxes to the package. Before placing these packages in the refrigerator, wrap each in wax paper and seal all the edges with either Scotch tape or adhesive tape. Do the same with the packages of occlusal and extra-oral films.

X-radiation.—Since refrigerators are made of metal, there should be no trouble from secondary radiation.

Make sure, however, that the refrigerator does not stand near the x-ray apparatus, where it is exposed to primary x-radiation. If it does and cannot be moved, a lead shield should be positioned either within or without the refrigerator protecting the film from such primary rays.

Chemical fumes.—Be sure that x-ray film is not stored with chemicals that can do damage through fumes. Especially injurious are vapors from formalin, hydrogen sulfide, and hydrogen peroxide.

Careful attention to the above details will prolong the useful life of x-ray film.

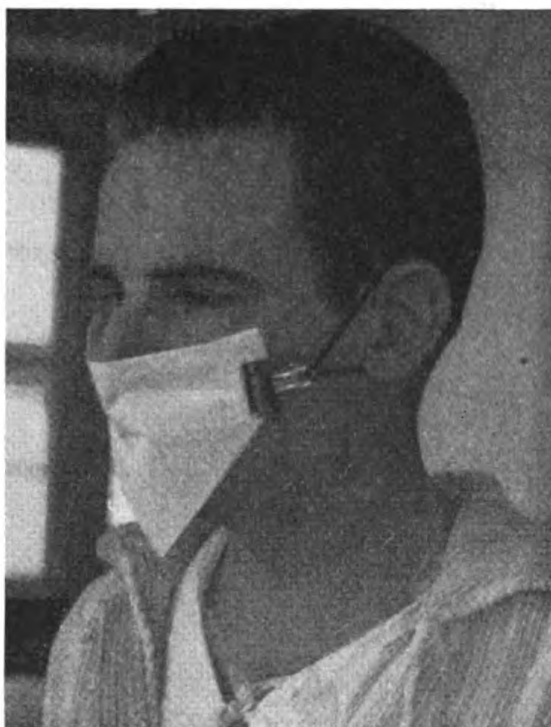
A SIMPLE FACE MASK¹

DAVID ULMAR

Lieutenant Commander (MC) U. S. N. R.

It is fairly universally conceded that a large number of infectious diseases are transmitted by means of the aspiration of sputum droplets sprayed from the source of infection. Most of the respiratory infections as well as many of the virus diseases may be considered in this category. It is obvious that any measures taken to control this droplet dissemination at its source are apt to be profitable. With this object in view, the mask which is about to be described is suggested for use.

The essential parts are an ordinary paper napkin, two small spring paper clips, or safety pins, and two rubber bands. The napkin is folded diagonally so that a triangular-shaped sheet is formed. The rubber bands are attached to the paper clips, and a clip is then fastened to each corner of the folded napkin. The napkin is worn as shown in figure 1.



1. PAPER NAPKIN FACE MASK.

The advantages of this type of mask are its ease of preparation and application, its cheapness and availability, its effectiveness.

It is suggested that these masks be used on all patients on whom chest examinations are being done, regardless of the diagnosis. In

¹ Received for publication January 11, 1943.

this way a potent protection is provided against the hazard of cross infection.

MULTIPLE STRETCHER HOIST¹

CHALMERS R. CARR

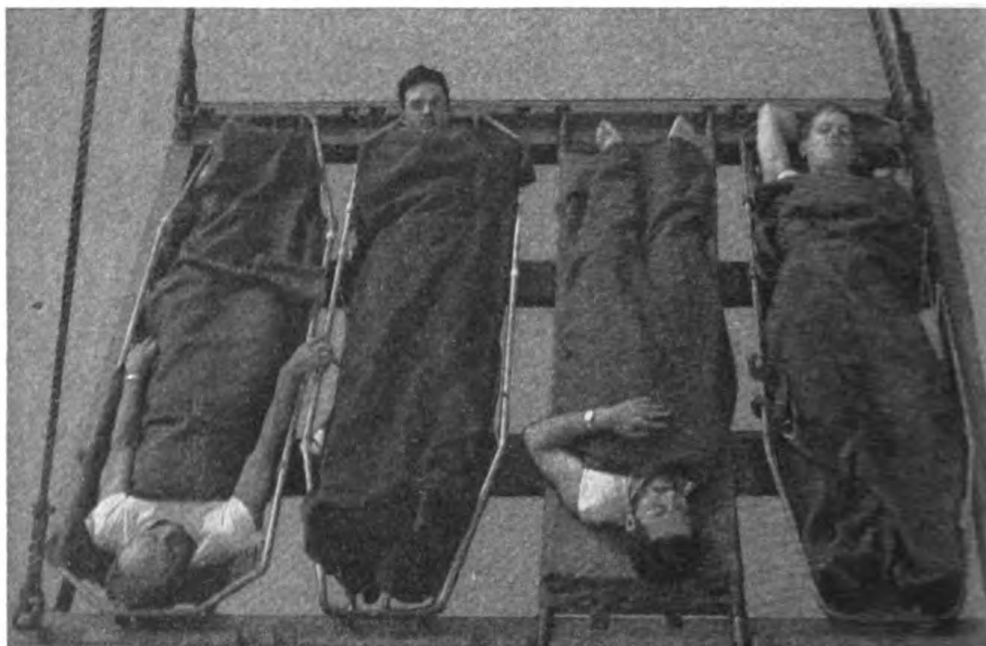
Lieutenant Commander (MC) U. S. N.

and

HOWARD C. ULLRICH

Carpenter U. S. N.

Loading and unloading casualties on a ship at anchor can be greatly facilitated by the preparation of proper gear beforehand. We present lay-out and picture of a four-stretcher hoisting platform which has proved to be of great value in rapidly transferring casualties between small boats and the ship. It will lend itself equally



1. SHOWING HOW BOTH POLE LITTER AND STOKES STRETCHER ARE ACCOMMODATED.

well to lowering stretchers to the dock, should brows be inadequate for hand carry.

The idea is not new, but we have not seen described before the detailed arrangement for securely and comfortably handling multiple litters, of either conventional type. This hoist will handle Stokes stretchers or Army-type pole litters, or a mixture of each. To ships

¹ Received for publication February 8, 1943.

not already equipped, which may handle casualties in amphibious operations, we can recommend an adequate number of these platform hoists. Their use will be found to expedite comfortable handling, an important consideration in a roadstead under imminent bombardment.

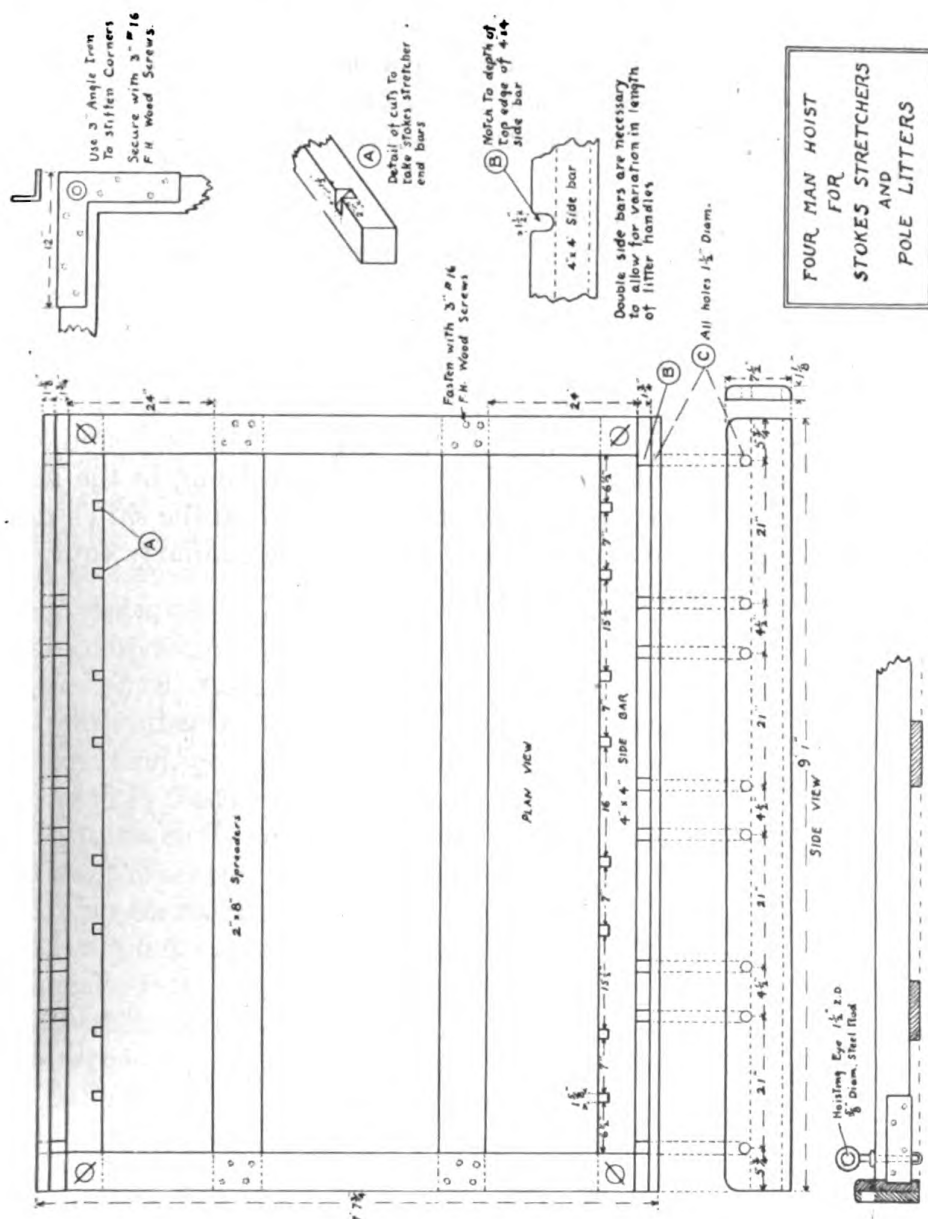


FIGURE 2.

The platform is readily constructed by the ship's carpenter. Any good grade of lumber is satisfactory; seasoned ash or fir is the stock of choice. As will be seen from the drawings, the structure is simple. The long sides of the rectangle are notched and sloped from the top to inner surface at the proper intervals to receive the longitudinal struts of the Stokes stretcher. The round notches on the

upper surface of the inner side bar, backed by the round holes in the outer side bar, are for seating and securing the handles of the pole-type litter. Because of the variations of pole length found in different litters, we have found both the notches and the holes necessary. We have not encountered any make of these two conventional litters which this hoist cannot handle.

In operation the platform is slung by a bridle, attached to the four corners with shackles, and handled by the cargo whip. Steadying lines are secured at two diagonal corners. The hoist can also be handled by boat crane.

When lowered the platform rests across the gunwales of a launch, landing boat, or tank lighter. In the large tank lighter it fits well between the ribs. Slack is let out on the bridle, as necessitated by the sea, allowing it to ride on the small boat while the handling crew in the boat is placing or removing the stretchers. Three men have been found sufficient to handle the boat end of the operation.

When moving a large number of patients it will be found convenient to have two platforms at the boom, one being in the small boat, while the other is being unloaded or loaded on the ship's deck. As many booms as the situation demands may be similarly equipped and the loading time proportionately reduced.

EDITORIALS

SULFONAMIDE FASTNESS

The indiscriminate application of the sulfonamides to disease has emphasized the fact that they are not panaceas. Failures have occurred under conditions where sulfonamide therapeutic effectiveness has long been established.

Such circumstances occurring in sufficiently increasing frequency have chilled the enthusiasm of some investigators, causing them to lose interest in the sulfonamides generally and inviting them to turn their endeavors toward other possibilities such as gramicidin, penicillin, propamidine, acridine, and the like.

Earlier workers on the sulfonamides were impressed by the fact that certain substances inhibited the bacteriostatic activity when the drug was applied topically.

Decomposition of injured, nonviable tissues, degenerating cell bodies of the bacteria themselves, have long been known to destroy the chemotherapeutic effect of the drug. Methionine, para-amino-benzoic acid, peptone, tissue extract, and purulent exudate soon were included in the list of inhibitors.

Failures in the oral administration projected into the problem the resistant character of the bacteria themselves and their uncanny neutralizing counterattack.

Attempted explanations of these facts introduced the terms "sulfonamide fastness," "sulfonamide resistant."

Whether the predominating factor in this fastness is a natural self-resistance or an acquired insensitivity of the organism to the drug is not definite.

However, while self-resistant strains were isolated from cultures obtained in the presulfonamide era, the available evidence indicates the probability of strains previously sensitive acquiring a tolerance, following repeated exposure to subtherapeutic quantities of the drug in the patient's tissues.

Inadequate sulfonamide dosage therefore is known to produce an acquired clinical resistance to further adequate drug therapy.

On the other hand, it has been demonstrated that a resistant strain can be transmitted from one host to another, retaining its drug-fast-

ness property. This seems particularly true in neisserian infections—a circumstance which emphasizes the necessity of adequate dosage, the elimination of haphazard tests of cure and of the premature cessation of treatment of defaulters.

Topically the presence of para-aminobenzoic acid in a lesion acts as a growth stimulant for certain bacteria and exerts a pronounced antisulfonamide activity.

These facts suggest that the self-resistant property of bacteria might depend upon the formation of para-aminobenzoic acid, the removal of which will minimize the antisulfonamide effect. Azochloramid and urea (carbamide) among other substances, having singular promise in this regard.

Whether the activity of these substances is an enhancement of the sulfonamide effect alone or a neutralization of the inhibitor mechanism, or both, is debatable.

Elsewhere in this issue (p. 1057) the effectiveness of urea-sulfonamide mixtures is discussed. Decidedly synergistic against certain organisms, urea-sulfonamide has the advantage of being relatively non-toxic. It is a strong peptizing agent exerting marked solvent action on necrotic tissue, pus, and detritus, thus chemically debriding contaminated wounds and mechanically at least removing inhibitors. It lyses bacteria, rapidly deodorizing foul-smelling wounds, and renders sulfonamides more soluble. It stimulates granulations, vascularization, and hyperemia. Uniformly effective, it permits many variations in its therapeutic application.

INTRAVENOUS THERAPEUTIC FLUIDS

The treatment of pathologic states affecting interchange of body fluids demands something more than generalizations. Such a course may lead to very grave danger. It is conceivable that battle conditions may alter the circumstantial aspects of the problem, but basically the approach should have intelligent understanding.

To crowd the circulating blood stream with additional fluid purely because it is at hand has often led to irreparable error. There was a time when salt and dextrose answered by rote every surgical intravenous replacement need, a circumstance that not infrequently produced edema and drowning of the patient in his own fluid. Due to the pioneering work of Hartman, Maddock, Collier, Wangensteen, and others, a more rational approach to this subject has come to the fore. The physiology of body fluids has taken on an intelligible aspect, exacting a knowledge that dissipates vagueness in the therapeutic application of these agents. In the light of recent investigations, intravenous fluids demand individual consideration.

Replacement of normal constituents of the blood presupposes cognizance of an imbalance occasioned by depletion of water, minerals, salts, protein, glucose, red and white blood cells, and platelets, fundamentals of the circulating blood stream. Feeding the patient intravenously to maintain food and fluid balance also involves consideration of vitamin therapy and other specifically indicated substances.

Drugs, bacteria, protein products, and the like may categorize the abnormal constituents of the blood—assuredly existent at times to the great disadvantage of the patient.

To the trilogy of modern therapy, morphine, sulfonamide, and plasma, may be attributable the decreased mortality in war casualties. Men have been known to go into battle, heartened with the knowledge that plasma was available to combat their wounds. Plasma, however, is not a blood substitute. It is a blood derivative and as such has its limitations even as have the other members of the triad.

There are circumstances when whole blood, and whole blood alone, must take precedence. In severe hemorrhage wherein the oxygen-carrying capacity of the blood is depleted and anoxia is present, replacement therapy demands supplying the medium of oxygen conveyance. Where there is anoxemia there is continued permeability, and the loss of fluid will be unchecked by any other substitute. Anemia, purpura, and monoxide poison, among others, are likewise definite indications for whole blood. Replacement by any other substitute attenuates the logic of this type of therapy.

Burns, shock, severe hypoproteinemia from liver disease, and the nephrotic syndrome are clear indications for the use of plasma. The maintenance of proper hydrostatic pressure within the capillary bed and the replacement of plasma protein in sufficient amounts by whole blood under these conditions may lead to severe overconcentration of red cells, increase viscosity, produce circulatory resistance, and overburden the heart.

In these circumstances, and in the prevention of shock, plasma is adequate. Its availability in quantity, general lack of unfavorable reaction, and pooling have entrenched this derivative as a therapeutic essential. Although perhaps physiologically less ideal than whole blood, its positive success has astounded conservative opinion.

Serum and the albumin fraction of the blood, on the other hand, demand more careful consideration, as their use is decidedly restricted. Serum as such has not been accepted as a blood substitute by the armed services.

Albumin, however, is of value in traumatic shock, burns, and hypoproteinemia. It is not a substitute for plasma, much less for whole blood. Its principal effectiveness is in reestablishment and maintenance of the colloid osmotic pressure of the blood. It increases blood

volume but at the expense of the tissue fluids, and hence in the presence of dehydration requires complemental fluids.

In the presence of uncontrolled hemorrhage, serum albumin may increase hemorrhage, aggravate existing dehydration, render worse an apparent anemia, and precipitate pulmonary edema. In traumatic shock, albumin is best limited perhaps to emergency procedures, while in burns it should be followed as soon as possible with citrated plasma.

Conversely the intravenous introduction of a diffusible crystalloid such as salt or dextrose to a patient in deep shock or dehydration may invite catastrophe. Such a procedure tends to wash out the plasma protein, may aggravate a hypoproteinemia to a critical level, and transform an impending state of subhydration to a visible edema.

Surgeons must rely upon a number of guides to determine the intravenous needs of a patient. Hydrostatic pressure, osmotic pressure, and the permeability of the capillaries enter into every intravenous situation. What kind of fluid should be given depends upon the water, electrolyte, blood loss factor, and caloric and nitrogenous requirements of the patient.

A simple circumstance can pyramid one or more of these requirements into an alarming situation. A momentary brisk bleeding, an episode of vomiting, aspiration through an indwelling duodenal tube, air transportation operations, and the like may suddenly dislocate an otherwise equilibrium status and precipitate a crisis.

Finally, selection of substance for fluid replacement presupposes intelligent assessment of involved factors, such as history, environment, available fluid, and physiologic and pathologic influences.

A healthy person presumably possessing a full complement of red cells, blood protein, chlorides, and a general good state of hydration suddenly stricken by disease, war violence, or accident, will require intravenous replacement therapy specifically adapted to the particular need. A severe hemorrhage demands whole blood; shock and its prevention with or without moderate hemorrhage calls for plasma or serum albumin limited to the above mentioned restrictions. Inability to take food or fluids by mouth is offset by the introduction of several liters of salt and/or dextrose solution within 24 hours, the repetition and quantity gaged by certain frequent laboratory determinations. Chronic protracted illness necessitates knowing the mineral supply, hemoglobin concentration, and total plasma protein before instituting intravenous therapy and supplying the deficit with definitive treatment.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

PSYCHOSOMATIC MEDICINE, The Clinical Application of Psychopathology to General Medical Problems, by *Edward Weiss, M. D., Professor of Clinical Medicine, Temple University Medical School, Philadelphia*; and *O. Spurgeon English, M. D., Professor of Psychiatry, Temple University Medical School, Philadelphia*. 687 pages. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$8.

The authors of this noteworthy volume have presented, in the best form, a textbook which must supplement all other works on medicine in the library of any physician doing general medicine, and particularly its subspecialties. Here at last is a textbook which comes close to covering the "art" of medicine, rather than the less warm "scientific" side. Much needed, and long awaited, this volume presents the proved facts known to date about the physiological reflections of psychological processes, not in a compilation, as has been the case in some of its predecessors, but in a workable, readable, practical application for which every practitioner has need.

Opening with two chapters on the fundamentals of psychosomatic medicine, and closing with four chapters on real therapy for this type of disorder, the authors have covered, between these two points, all angles of their subject, arranging their material by systems, which makes it particularly usable for reference. The very good chapter on military medicine should be required reading for all medical officers of the armed services, and especially for those charged with the after care of veterans invalidated from the service. This section could have been improved had the authors thought to obtain material from some of the men who have been doing an outstanding job of psychiatric selection of men for the Navy for almost 2 years. They are forgiven, however, because of the chapter entitled "'Normal' Problems in Psychotherapy," which in itself is a manual of childhood and adoles-

cent psychiatry, the latter a subject of paramount importance to the armed services at this time. An excellent bibliography tops off the entire work.

One word of warning to those to whom the name "psychoanalysis" is poison—this is based on Freud. And, in the words of "old Bill," if they know a better 'ole, let them run for it.

SULFANILAMIDE AND RELATED COMPOUNDS IN GENERAL PRACTICE, by *Wesley W. Spink, M. D., F. A. C. P.*, Associate Professor of Medicine, University of Minnesota Medical School. Second edition; 374 pages. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1942. Price \$3.

No more ambitious undertaking could have been attempted than the writing of a textbook on this subject in view of the tremendous volume of experimental research and clinical progress made from month to month. However, the need for such a work to condense the voluminous literature and to present in a brief, readily available, and handy reference the established and proven usages and values of these drugs in clinical practice is self evident. The author has accepted this challenge with the result that this second edition undoubtedly represents to date the most complete and accurate summary of the advances made in sulfonamide therapy which have withstood the acid test of clinical application.

The material is logically presented to cover each field of practice with its special problems in such a manner that the information desired can be obtained with a minimum of reading. A definite plan of attack is given for the treatment of each disease entity. This feature makes the book most helpful to medical personnel recently inducted into the armed forces, many of whom are required by circumstances to treat a wide variety of cases hitherto outside the scope of their civilian practices.

The 64-page bibliography is in itself a major contribution affording a ready reference to the original literature and encouraging the reader to seek additional information on any point which may to him seem controversial.

The author is to be congratulated on the publication of a basic guide for the general practitioner, and in fact for all who use the sulfonamide drugs today. This book should be on every desk and is an amazingly successful attempt at the impossible—to keep a practical text or handbook abreast of the almost daily progress of experimental and clinical research.

THE SURGICAL CLINICS OF NORTH AMERICA, December 1942, volume 22, No. 6, Philadelphia Number, by 24 contributors. 300 pages, including a 3-year cumulative index to volumes 20, 21, and 22 (1940, 1941, and 1942). W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$16 per set. (Published bimonthly.)

Although this book contains much of interest to the general surgeon, it has a wealth of information for those who practice traumatic surgery

and particularly for the great group now handling war casualties. It is divided into 13 sections written by separate scientists or groups of scientists and is concerned with 9 distinct surgical problems. These problems are presented in such a clear, concise, and pointed manner that the reading of the book is a pleasure. The binding is unchanged from that of the similar volumes.

The section on the "Stader Reduction and Fixation Splint for Treatment of Fractures" is particularly well written and illustrated. This method may prove to be the opening of a new chapter in the treatment of fractures. Four sections deal with the application of the sulfa drugs to surgery as a whole. They form a true compendium of that important subject. "One Stage of Abdominal Proctosigmoidectomy" is informative for any physician in active practice. "Islet-Cell Adenoma of the Pancreas" and "Pancreatic Cyst: Report of Five Cases" describe and illustrate clearly the subjects of their discussions. "The Fate of Transfused Refrigerated Blood and the Problem of Blood Banks" and "Plasma and Serum as Blood Substitutes" may well have been written for the present era of war casualties in which these play a most vital role. "Continuous Spinal Anesthesia in Abdominal and Thoracic Surgery" concerns two thousand such cases. "Surgical Diagnosis in the Mental Case," of primary interest to relatively few surgeons in times of peace, becomes increasingly important to the war surgeons. Lastly, but only so in its location in the book, "The Control of Fluid Balance by Laboratory Methods" admirably treats of one of the most troublesome problems of any surgical operation.

FRACTURES, by *Paul B. Magnuson, M. D., F. A. C. S., Associate Professor of Surgery, Northwestern University Medical School, Attending Surgeon, Passavant Memorial Hospital and Wesley Memorial Hospital, Chicago.* Fourth edition, revised; 511 pages with 317 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1942. Price \$5.50.

Brought up to date by inclusion of timely discussions on first aid, transportation, and early treatment of compound fractures, this fourth edition fills a worthy niche in fracture literature.

The treatment of compound fractures is directly prescribed for military service, making the volume a wartime treatise.

A well-illustrated text, the surgical drawings by W. C. Shepard materially enhance the value of the book.

AMPUTATIONS, A Monograph from Volume III, *Lewis' Practice of Surgery*, by *N. T. Kirk, M. D., Colonel, Medical Corps, United States Army; Chief Surgical Service, Walter Reed General Hospital; Director of Surgery, Army Medical School, Washington, D. C.* 229 pages; illustrated. W. F. Prior Company, Inc., Hagerstown, Md., publishers, 1942. Price \$3.

The subject of amputations has finally received its deserved consideration in the form of an excellent monograph. For the military surgeon and for those interested in traumatotherapy this treatise fills

a real need, while the occasional operator will find it to be a valuable reference book.

The material presented has been selected by the author during his long and unparalleled experience in dealing with amputations, and it is presented in a very readable fashion. The illustrations are numerous and well chosen. Many time-honored but illogical procedures in this field of surgery have been omitted in favor of practices that have proved more satisfactory in the hands of the author.

The subject of prostheses is appropriately emphasized, and the reader cannot fail to appreciate its importance in the rehabilitation of these patients.

CHANGES IN THE KNEE JOINT AT VARIOUS AGES, With Particular Reference to the Nature and Development of Degenerative Joint Disease, by Granville A. Bennett, M. D., Associate Professor of Pathology, Harvard Medical School; Hans Waine, M. D., Research Fellow in Medicine, Harvard Medical School; and Walter Bauer, M. D., Associate Professor in Medicine, Harvard Medical School. 161 pages, illustrated. The Commonwealth Fund, New York, publishers, 1942. Price \$2.50.

This neatly bound book consists of 79 pages of subject matter correlated with 31 photographic studies of microscopic knee-joint pathology. The topics are clearly and concisely presented so as to give the reader a most accurate picture of degenerative joint changes. The book is most unique in that all articular disorders usually classified as osteoarthritis, degenerative arthritis, arthritis deformans, etc., are herein designated as a stage of what the authors consider degenerative joint disease.

The bibliography concerned with the publication is extensive. The studies reported in this volume were obtained from a large number of postmortem examinations of all ages who gave no history or clinical evidence of articular disease. The primary purpose of the work was to familiarize the writers with the so-called normal knee joint at each decade of life, but has evolved a most interesting classification of joint pathology. The book is recommended to every doctor who is interested in joint pathology.

ORTHOPEDIC SUBJECTS, prepared and edited by the Subcommittee on Orthopedic Surgery of the Committee on Surgery of the Division of Medical Sciences of the National Research Council. 306 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$3.

Conspicuous for clarity and brevity this fourth volume of *Military Surgical Manuals* is a worthy representative of the series.

Among other features the table of contents includes ununited fractures, injuries to the spinal column, compound fractures, and osteomyelitis.

Probably one of the clearest things written on osteomyelitis, the detailed account of the progress of this disease from incipency to

necrosis of the bone with recovery or death of the patient, is admirably portrayed.

The discussion on compound fractures and the surgical management of gas gangrene alone will amply repay the military surgeon for his time spent in perusing this volume.

THE 1942 YEAR BOOK OF INDUSTRIAL AND ORTHOPEDIC SURGERY, edited by *Charles F. Painter, M. D., Orthopedic Surgeon to the Massachusetts Women's Hospital and Beth Israel Hospital, Boston.* 424 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1942. Price \$3.

As is to be expected this is a coverage of those diagnostic or operative developments of the year which promise most permanence. It is essentially abstracting, but with a year's output to choose from. This is probably the best of refresher courses for the man in general practice or in military service. It is of more value to him than to the orthopedic specialist, who if he keeps abreast as he must, will have seen these developments as they were contributed during the year.

General orthopedic conditions are broadly covered, war complications quite sketchily. The closing chapters on industrial medicine contains excellent items on the highly pertinent subject of socialization of medicine, as well as valuable contributions on industrial health hazards.

DISEASES OF THE LIVER, GALLBLADDER AND BILE DUCTS, by *S. S. Lichtman, M. D., F. A. C. P., Adjunct Physician, Mount Sinai Hospital,* 906 pages, illustrated with 122 engravings. Lea & Febiger, Philadelphia, Pa., publishers, 1942. Price \$11.

The full title of this volume as indicated on the title page is "Diseases of the Liver, Gallbladder, and Bile Ducts," which perhaps more fully justifies the apparent discrepancy between the subject to be covered and the excessive thickness of the tome.

It would seem that there is a definite need for a compilation of this type, bringing up to date in one volume the past and current work in this field. As such, however, this volume is disappointing in many respects. While complete and profound from an academic standpoint, it is not easy reading. Sentences such as "The omission of meat from the diet or of bile salts may thus favor the inhibitory influence of certain extrahepatic biliary factors on the biliary secretion despite the fact that the remainder of the diet is suitable in every other respect" (which the author felt impelled to italicize) leaves this reader floundering as to his exact meaning. Such examples of ambiguity and seemingly unnecessary verbosity are common throughout the book.

However, the sections dealing with specific disease are, on the whole, presented more concisely. Special commendation should be

given to the completeness of the section dealing with laboratory tests for various hepatic functions. The illustrations are many and well prepared, although few are original.

This text has definite value as a reference on hepatology, although in this reviewer's opinion, such value would be greatly enhanced by a thorough "streamlining" in the modern manner.

LABORATORY DIRECTIONS IN BIOCHEMISTRY, by *Victor C. Myers, M. A., Ph. D., D. Sc., Professor of Biochemistry, Western Reserve University.* 288 pages. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$3.50.

Dr. Myers has put in book form the mimeographed laboratory directions which are issued to the biochemistry students at Western Reserve University. These directions, therefore, might be useful in other schools which follow the same general outline. They are chiefly those for the classical determinations in biochemistry, including several modifications of these by the author. There is little accompanying explanatory text. Unfortunately, many of the newer methods are omitted. For example, no methods are given for fecal or urinary urobilinogen or porphyrin,^o or for serum ascorbic acid and the likelihood of urinary sulfonamide crystals is not even mentioned. Thus, this book cannot supplant any standard laboratory manual but would probably be of some value in an introductory biochemistry course.

Typewriter face type is used in mimeograph fashion and the book is bound in a loose-leaf binding with paper covers. If it is the purpose of the author and publisher to issue supplementary pages, this is distinctly advantageous. Students, who might wish to detach the pages to take to class, would also be pleased with this. However, the pages are easily torn loose and, in a book used as roughly as a laboratory manual, might soon become lost.

SURGICAL PATHOLOGY, by *William Boyd, M. D., LL. D., M. R. C. P. Ed., F. R. C. P., Lond.; Dipl. Psych., F. R. S. C., Professor of Pathology, University of Toronto.* Fifth edition, thoroughly revised. 843 pages with 502 illustrations and 16 colored plates. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$10.

The fifth edition of Dr. William Boyd's well-known and widely used "Surgical Pathology" will undoubtedly prove an adjunct to the library of any surgeon, pathologist, or pathological laboratory. The edition is a thorough revision of previous works and contains much new material.

The new subject matter is timely, including, among others, mention of wound infections, burns, head injuries, and pulmonary blast injuries. The new chapter on "Surgical Pathology of the Thorax" is deserving of especial note. The substitution of photomicrographs for drawings

has been a noteworthy improvement over previous editions. The listing of references under subject headings is also a welcome innovation. The volume contains 843 pages, is profusely and well illustrated, and of print beyond criticism.

The technical problems encountered in the preparation of a volume of this type are manifold. The author and his assistants are to be congratulated on the thoroughness with which the task has been completed. The book is recommended for those to whom the subject is of interest.

MEDICAL PARASITOLOGY, by *James T. Culbertson, Assistant Professor of Bacteriology, College of Physicians and Surgeons, Columbia University*. 285 pages, illustrated. Columbia University Press, New York, publishers, 1942. Price \$4.25.

This excellent book covers the significant facts about medical parasitology. As the book is intended primarily for medical practitioners and medical students, much nonessential detail of parasite morphology and taxonomy has been omitted. The style is simple and direct. There are two main divisions. Part I deals with infection, epidemiology, natural resistance, acquired immunity, diagnosis, specific therapy, and prophylaxis. Part II deals with the infections caused by animal parasites.

The work is attractively bound, printed in large type on nonglossy paper, and contains a number of instructive plates, figures, and tables.

It is recommended as an excellent introduction to the study of this increasingly important subject.

THE HEMORRHAGIC DISEASES AND THE PHYSIOLOGY OF HEMOSTASIS, by *Armand J. Quick, Ph. D., M. D., Associate Professor of Pharmacology, Marquette University School of Medicine*. 340 pages; illustrated. Charles C. Thomas, Springfield, Ill., publishers, 1942. Price \$5.

Few monographs have been written on either blood coagulation or the hemorrhagic diatheses. Dr. Quick's effort, therefore, to summarize the knowledge on these two subjects is, to say the least, distinctly praiseworthy. He is well qualified to undertake such a task inasmuch as his role in the recent researches in hypoprothrombinemia has been significant. The work, undoubtedly the best of its type thus far, illustrates aptly, however, the reason for the scarcity of texts on these fields. The preface is dated June 1942, and in the months, few as they have been, following the compilation of the material and its publication, advances have taken place of such importance as to make revision of two or three of the chapters advisable. This is not intended as deprecatory but rather to emphasize the difficulties of writing a monograph on fields as controversial and rapidly changing as these.

The bibliographies following each chapter are excellent and complete. Surprisingly few typographical errors were encountered. The

book is well printed on semiglossy paper and bound with linen. There are only two illustrations, one of which is in color, of typical lesions in patients.

PRACTICAL SURVEY OF CHEMISTRY AND METABOLISM OF THE SKIN, by *Morris Markowitz, M. D.*, Associate in Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania. 196 pages. The Blakiston Co., Philadelphia, Pa., publishers, 1942. Price \$3.50.

The author presents in this small book, which has a sturdy binding and printing that is easy on the eye, a general survey of fundamental facts necessary for a better understanding of dermatology. In addition to the chemistry and metabolism of the skin tissues, he includes blood chemistry as related to cutaneous diseases and hematopoietic changes related thereto.

After enumerating all the known vitamins, the author discusses the dermatoses which are due directly or indirectly to avitaminosis. He then summarizes the results of vitamin therapy as indicated by the writings of authenticated investigators. It is to be regretted that the author expressed no opinions as to the results of vitamin therapy in his own hands or in those of his associates.

This book can be recommended to students and general practitioners for an introduction to these subjects and to dermatologists as a book of reference. The bibliography which is placed at the end of each of the four parts into which the book is divided is very comprehensive and deserves a special word of praise as the author has chosen only those works that are of a scientific and substantiated value.

MANUAL OF DERMATOLOGY, Issued under the Auspices of the Committee on Medicine of the Division of Medical Sciences of the National Research Council, by *Donald M. Pillsbury, M. D.*; *Marion B. Sulzberger, M. D.*; and *Clarence S. Livingood, M. D.* 421 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$2.

In the United States Navy during the past 10 years, skin diseases produced 9.79 percent of all admissions to the sick list; Army figures (1940) quote 9.80 percent.

Ten percent of all admissions are dermatological in peacetime; conditions of warfare carry with them contacts that render a rapid relative increase unavoidable. The authors estimate that "it can be conservatively stated that some 20 to 25 percent of all diseases in the armed forces are the object of dermatosyphilologic management." Such facts are strong arguments for the wide distribution of this most excellent handbook.

It opens with a very sensible short chapter on "Directions for the Use of the Manual," which is the precursor of a logical and clear coverage of the entire subject. The military and naval viewpoints

are stressed repeatedly. Over a hundred illustrations, largely full-page photographs are most enlightening. Extended verbiage is avoided; descriptions and treatments are meaty but concise.

It is difficult to see how any specialty could be more thoroughly and satisfactorily covered in what is practically a pocket-sized manual. This is the first of the Military Medical Manuals, sponsored by the National Research Council, and this reviewer regrets that the Surgical Manuals were not of the format of this one. The semi-limp back, and the smaller page make it a much handier volume for field or seagoing use.

DISEASES OF THE EYE, by *Sir John Herbert Parsons, C. B. E., D. Sc., F. R. C. S., F. R. S., Consulting Ophthalmic Surgeon, University College Hospital*. Revised with the assistance of *H. B. Stallard, M. A., M. D., F. R. C. S.* Tenth edition, 726 pages with 21 plates and 372 text figures. The Macmillan Co., New York, publishers, 1942. Price \$8.50.

The fact that this book is the tenth edition over a period of 25 years is proof of its importance as a textbook of ophthalmology. The problems of diseases of the eyes are presented in a clear and concise manner. The section on anatomy and physiology of the eye forms an excellent background for the material which follows. The sections on disorders of motility and the ocular manifestations of diseases of the nervous system and other diseases are well written and authoritative. In the new work, there has been a revision in the methods of production of local and general anesthesia of immobilization of the site of operation by nerve block, and in the operative technic in keeping with recent advances.

The book is well illustrated and the colored plates are excellent. It is an excellent introduction to the study of the diseases of the eye.

MENTAL ILLNESS: A GUIDE FOR THE FAMILY, by *Edith M. Stern* with the collaboration of *Samuel W. Hamilton, M. D.* 134 pages. The Commonwealth Fund, New York, publishers, 1942. Price \$1.

The average layman's idea of a mental hospital is an extremely distorted one and is far from the truth. Small wonder that when a friend or member of the family becomes mentally ill that they look with misgivings upon the prospects of treatment in a mental hospital. This little volume will go far towards dispelling the erroneous ideas connected with mental illness and mental hospitals.

The book is a gentle, sane, complete set of instructions for the guidance of the family during the trying time that relatives and friends are mentally ill. The book does not attempt to delve into symptomatology or diagnosis, in fact it is refreshingly free from clinic dissertation. Several chapters are particularly noteworthy, namely, the ones which describe the formidable procedure of getting

the patient to the hospital and another which describes how to act toward him when he gets home. The volume is well written. It neither talks up nor down to the distressed relatives, and all in all it is quite satisfactory.

There is a foreword of Dr. Samuel Hamilton, a man with long experience in dealing with mental disease. The book will appeal mostly to psychiatrists connected with institutions. Obviously there is little use for it in the armed forces.

LOVE AGAINST HATE, by *Karl Menninger, M. D.*, with the collaboration of *Jeanetta Lyle Menninger*. 311 pages. Harcourt, Brace and Company, New York, publishers, 1942. Price \$3.50.

The present volume is a popular treatment of common emotional conflicts and their effect on the human personality. It is highly psychoanalytic in nature as will be noted by the stress placed on instinctive drives and their thwarting by the codes of modern civilization.

Much of the book deals with the frustrations of children and women. In the chapter, "The Frustrations of the Child," the author points out how the child is thwarted by social codes and how such thwarting brings about hate. Such hate is usually directed toward the mother because of her close association with the child. Seven things that should be guaranteed every child to assist his adjustment are listed.

The chapter, "The Frustrations of Women," contends that women are frustrated mainly because they are living in a man's world, they are denied love, and passivity on the part of the husband. This adversely affects in turn the woman, the child, the man, and then the woman again in a circular fashion. The remainder of the book is devoted to practical suggestions as to how this "vicious circle" can be broken.

Many will find the present volume a disappointment when compared with Menninger's previous books. Certainly it does not come up to the standards exemplified in his well known work, "The Human Mind," While the layman may find it stimulating, psychiatrists and psychologists may find it redundant.

There are 10 chapters covering 294 pages; plus an index and a section on source notes. The type is large and clear and the binding is fair.

YOU MUST RELAX, A Practical Method of Reducing the Strains of Modern Living, by *Edmund Jacobson, M. D.* Revised edition; 261 pages; illustrated. Whittlesey House, New York, publishers, 1942. Price \$1.75.

The present volume, a revision of the 1934 edition, has been extended to include three new chapters, two on sleep and one on war nerves. It is essentially a book for the layman, written with a view toward providing suggestions for the alleviation of certain nervous conditions.

Throughout the book the author stresses the importance of relaxation—specifically “progressive relaxation,” as opposed to mere rest—in dealing with persons who are overtense and nervous. Descriptively, the book may be divided into three parts, the first dealing with the causes of nervousness and the need for relaxation, the second dealing with instructions and exercises to induce complete relaxation, and the third dealing with the therapeutic effects of relaxation on certain specific conditions, e. g., sleeplessness, indigestion and colitis, and high blood pressure.

The volume is open to criticism in that it stresses “single principle” therapy. Progressive relaxation as a therapeutic measure is emphasized at the expense of other accepted technics. Perhaps the weakest chapter of the book is that on “Common Nervous Disorders,” wherein the author omits mention of many of the known mechanisms underlying neurotic behavior.

The book is written in a popular vein, and technical terminology is avoided. It will doubtless appeal to the layman, since it discloses a comparatively new approach to problems and conditions brought about by the pace of present-day living. In an attempt to make the exercises less difficult to follow, the author has included numerous plates depicting the methods of relaxation.

There are 17 chapters covering 243 pages, together with an index. The book is printed on nonglossy paper and contains 27 figures which are clear and well defined. The type is large and easy to read and the binding is satisfactory.

WHAT THE CITIZEN SHOULD KNOW ABOUT WARTIME MEDICINE, by *Joseph R. Darnall, M. D., Lieutenant Colonel, Medical Corps, United States Army*; and *V. I. Cooper*. 237 pages. W. W. Norton & Co., Inc., New York, publishers, 1942. Price \$2.50.

The volume covers the field of preventive wartime medicine and therapeutics in a concise and readable manner. The survey of available literature has been exhaustive, and the presentation in digest form is well organized.

The chapters on military psychiatry, communicable and infectious diseases, the wartime venereal program, and aviation medicine are especially well handled. The inclusion of civilian and public health problems occasioned by war conditions should appeal to the average reader.

It is evident that some of the figures quoted are from pre-war estimates. Certain inaccuracies also exist in the chapter on the Medical Department of the Navy, with relation to the training of hospital corpsmen as well as the special training schools for medical officers. On the whole, however, the material presented gives the nonmilitary lay reader a fundamental background of wartime medical organization and problems.

MEDICAL ORGANISATION AND SURGICAL PRACTICE IN AIR RAIDS, by *Philip H. Mitchiner, O. B. E., T. D., D. L., M. D., M. S., F. R. C. S., Hon. Surgeon to H. M. The King; and E. M. Cowell, O. B., O. B. E., D. S. O., T. D., D. L., M. D., B. S., F. R. C. S., Surgeon, Croydon General Hospital; foreword by Sir Outhbert Wallace, Bt. K. C. M. G., C. B., F. R. C. S., Consulting Surgeon, St. Thomas's Hospital.* Second edition. 296 pages with 58 illustrations. The Blakiston Co., Philadelphia, Pa., publishers, 1941. Price \$3.25.

In a clear, concise, and almost outline fashion the authors have presented an authoritative and detailed account of the many problems confronted during air raids, of the organization of medical facilities in order to provide the greatest possible benefit to air raid casualties, and of the clinical management of individual injuries. The experiences of World War I, Spain, China, and the present war have given the authors ample opportunity to amass considerable first-hand knowledge of the various phases of this problem.

The opening chapter deals with the organization and administration of civil medical services in air raids, and the last two chapters are concerned with special features of nursing organizations and the organization of the operating theater. Between these two aspects is an account of the various types of injuries encountered and the methods of treatment recommended. Four appendices are added which briefly discuss first aid, medical transport, surgery and chemical warfare, mobile x-ray units, and suggestions to officers in charge of convalescent homes and auxiliary hospitals.

Handled in considerable detail with simplicity of style and excellent organization of material, the result is an easily readable and practical account of the multitude of problems encountered and the manner in which they have been met. The clinical aspects are discussed with brevity and succinctness, and many short cuts in organization, treatment, and first aid are made possible as a result of the extensive experiences of the authors.

THE HOSPITAL CARE OF THE SURGICAL PATIENT, A Surgeon's Handbook, by *George Crile, Jr., M. D., Surgeon, Cleveland Clinic, Cleveland; and Franklin L. Shively, Jr., M. D., Assistant Surgeon, Cleveland Clinic, Cleveland.* 184 pages; illustrated. Charles C. Thomas, Springfield, Ill., publishers, 1943. Price \$2.50.

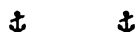
The authors state in their introduction that the book should be profitable to a surgical house staff, and that it should well serve its purpose. The opinion of the reviewer is that the greatest value of the book would be to a man just out of medical school and who is entering upon his internship or residency. It would also be suitable for the surgical nursing staff, but would be of little interest to the trained surgeon.

The book is divided into four sections that deal with physiological conditions related to the care of the surgical patient; the management of surgical complications; the technic of common hospital procedures; and the relationship of the house officer to them. The book is well

written, well arranged, and should be of great help to the group for which it was designed.

PERIODONTIA, A Study of the Histology, Physiology, and Pathology of the Periodontium, and the Treatment of Its Disease, by *Henry M. Goldman, D. M. D., Instructor in Oral Pathology, Harvard School of Dental Medicine, Harvard University.* 407 pages with 310 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$7.50.

Doctor Goldman handles the subject of periodontia logically and concisely in five chapters, namely: Examination, Diagnosis, Etiology, Physiology, and Pathology and Treatment. The manuscript is well illustrated with numerous excellent photomicrographs and photographs of clinical cases, some of which are reproduced in color. The references used throughout the text are authoritative. This new work on periodontia should provide a welcome addition to any dental library.



LOCAL CHEMOTHERAPY IN INFECTED WOUNDS

To study the effects of local chemotherapy in infected wounds, counts were made of the concentration of viable bacteria. Pus was taken always from the same spot, suitably diluted and plated out, in the presence of p-aminobenzoic acid. Twenty wounds were thus studied over a period of 1 to 3 weeks. In a typical case, treated with a mixture of sulfanilamide and sulfathiazole, the chief contaminant, a streptococcus, diminished rapidly in numbers, while other organisms, *Staph. aureus* and a nonhemolytic anaerobic streptococcus, were only slightly diminished; later, there was a gradual steady rise in the numbers of all three. This secondary rise is a characteristic finding, and it may be due to acquired resistance of the bacteria. The clinical condition of the wounds improved rapidly, and in spite of the persistence of the organisms, healing was nearly completed at the end of three weeks.

Chronic indolent wounds are usually infected primarily with hemolytic staphylococci and *Ps. pyocyanea*, with occasionally *Bact. coli*, accompanied by nonpathogens such as diphtheroids, *N. catarrhalls*, and nonhemolytic streptococci; in this type of wound, hemolytic streptococci are rare. The bacteriological improvement in such wounds was greater than had been expected. Sulfathiazole is probably more effective than sulfanilamide; in particular, it has been of great value in the treatment of obstinate tuberculous sinuses, several of which healed under this treatment; presumably, the good effect was due to bacteriostasis of secondary contaminants.

Cases are described of wounds with mixed infections which showed a good bacteriological response to treatment with sulfathiazole powder; the numbers of bacteria were greatly diminished and secondary suture or skin grafting became possible at an early date. The separation of sloughs was apparently not delayed by the sulfathiazole, and conversely, the presence of necrotic tissue did not seem

to nullify the chemotherapy. Sulfathiazole was used for the more chronic wounds, and those in which staphylococci predominated, sulfanilamide for acute and streptococcal lesions; in some cases a mixture of the two was employed. The beneficial influence is attributed to the local action of the sulfonamide, and not to any general systemic effect.

In eight cases, in which 1.5 gm. of sulfonamide was applied to wounds measuring 4-7 sq. cm., the concentration of the compounds in the blood was measured; after sulfanilamide it reached about 1.0 mg. percent and after sulfathiazole it reached 0.2-0.8 mg. percent. With wounds of a larger area, the blood concentration may conceivably rise higher and in such cases, caution may be necessary. In the eight cases under discussion, the proportion of the drug excreted in the urine during the first 36 hours after application amounted to 11 to 30 percent of the quantity applied for sulfanilamide, and 3 to 19 percent for sulfathiazole; the concentration in the urine was 6-24 mg. percent for sulfanilamide and 2-12 mg. percent for sulfathiazole. Hence it is important to watch the renal function of these cases, to exclude the possibility of damage.—Matthews, D. N.: The value of local chemotherapy in wounds and burns. *Bull. War Med.* 3: 307-308, Feb. 1943 (abstr. fr. *Lancet*. 271-5, September 5, 1942).

THE DIVISION OF PREVENTIVE MEDICINE

Commander T. J. Carter, Medical Corps, United States Navy, in charge

AN OUTBREAK OF FOOD INFECTION

The majority of so-called food poisoning outbreaks in the Navy clinically appear to be typical "enterotoxin intoxication" outbreaks. In spite of this, attention is called to the fact that *Salmonella* infection does occur and may seriously impair the effectiveness of an activity. This is borne out by the following report of such an outbreak:

On March 22, 1943, approximately 50 percent of the total personnel aboard one naval vessel suffered from food infection. Clinically the cases presented varying degrees of the following: Sudden onset with headache, chilly sensations, and fever, followed shortly by abdominal cramping, and a few hours later by copious watery diarrhea lasting from 12 to 84 hours. Generalized muscular aching and vomiting were prominent symptoms. Temperature ranged from normal to 106° F. The last cases were discharged from the sickbay 6 days later.

Epidemiological investigation incriminated roast chicken and dressing as the responsible article of food. This was prepared early, carved, and left in warming pans for 6½ hours before serving. Inspection of the mess cooks detailed to carve these chickens revealed one with pustular lesions on one hand and forearm, and another with several recent entries to the sick list with diagnosis of "acute gastro-intestinal condition." Although it is unlikely that the pustular lesions were in any way involved in this outbreak, the personnel were unduly exposed to the likelihood of "food poisoning." It is reasonable to assume that the "acute gastro-intestinal condition" recently suffered by the second mess cook was a *Salmonella* infection and that he was the source of this outbreak.

The importance of preventive measures is realized by all medical officers. To maintain effective combat units, recurrences of such outbreaks must be prevented. The following recommendations will materially aid in this direction:

1. Proper refrigeration of all meats immediately after cooking, at a temperature of below 45° F., unless it is to be served immediately.
2. Slicing or similar "handling" of all foods should not be done more than 3 hours before actual serving.

3. Frequent inspection of all food handlers. Those ill or who have pustular lesions should be relieved of duty. All with gastro-intestinal upsets should be excluded from such work until they have recovered clinically. Individuals who have diarrhea with fever should be excluded from food-handling duties until they have been symptom-free for 1 week.

4. Instructions to all food handlers on the importance of personal hygiene, with special emphasis on proper handwashing after visiting the "head."

THE IDENTIFICATION OF SALMONELLA CULTURES

LA VERNE A. BARNES

Lieutenant H-V(S) U. S. N. R.

At the present time there exist over 164 distinguishable strains of micro-organisms belonging to the *Salmonella* group (1). Approximately one-fourth of the standard *Salmonella* strains have been recovered from human infections, the balance from various bird and animal sources. It should be noted that, although the majority of these organisms are not of immediate human origin, all members of the genus *Salmonella* must be considered as potential etiological agents in sporadic or epidemic outbreaks of gastro-enteritis or enteric fever in man.

Upon occasion, *Salmonella* infections in man may be severe, of long duration, or may terminate fatally; cases of meningitis due to members of this group are not uncommon. Under any circumstances, however, the illnesses produced result in a loss of man-hours that is of military significance.

When a group of individuals become ill within 18 to 36 hours after eating at the same mess, statistical analysis may incriminate a specific article of diet as the probable source of common infection; such a survey does not, however, furnish adequate proof. From the epidemiological standpoint, therefore, it is of great value to determine whether a case or outbreak of such infections is due to a *Salmonella* and, if so, its exact identity. This is true because adequate control measures depend to a certain degree upon the original source of food contamination—that is, whether the causative agent was introduced by a human carrier or came from animal sources. Such determinations can be made only by careful and accurate laboratory procedures. It is the purpose of this communication to outline briefly the satisfactory methods to be employed in achieving such objectives.

DEFINITION

As stated by Edwards and Bruner (1), probably the best definition of the genus *Salmonella* is that proposed by the *Salmonella* Subcom-

mittee of the International Association of Microbiologists (2) which emended the definition of White (3) as follows:

A large genus of serologically related, gram-negative and nonsporing bacilli; 0.4 to 0.6 μ by 1 to 3 μ in usual dimensions, but occasionally forming short filaments; showing, with certain exceptions, a motile peritrichous phase in which they normally occur; in fact, adhering to the pattern of *B. typhosus* in staining properties and morphology. Failing to ferment sucrose or to clot milk and rarely fermenting lactose, liquefying gelatin or producing indole, they regularly attack glucose with, but occasionally without, gas production. All the known species are pathogenic for man, animals, or both.

It must be remembered that there are many variations in the cultural and physiological characteristics of members of the genus; training, experience, and alertness are of great importance in recognizing *Salmonellas*. In general, however, it may be said that any culture which ferments lactose, sucrose, salicin or adonitol, forms indole, or liquefies gelatin is, a priori, *not a Salmonella*.

PRELIMINARY IDENTIFICATION

It is expected that field and station laboratories will conduct the preliminary cultural and biochemical studies of cultures isolated from cases or outbreaks of suspected food infection. A brief review of suitable procedures may be in order.

Fecal specimens may be suspended in 0.6 percent NaCl solution containing 30 percent neutral glycerin; this step is of particular value when it is not possible to plate out the specimen within a short time after passage of the stool. If the sample cannot be cultured within a few hours after collection it should be refrigerated if at all possible. The suspensions are plated on a differential medium such as MacConkey's, eosin methylene blue, bismuth sulfite, desoxycholate, or desoxycholate citrate agar. If tetrathionate broth is available, it may be of value to inoculate 1 to 3 gm. of the infected material directly into 10 ml. of the medium, incubate overnight, then if growth occurs, streak plates of differential media as suggested above. The use of tetrathionate broth should not, however, preclude the direct plating of the specimen. All plating should be done in such a manner as to ensure the development of well-isolated colonies. A small portion of typical colonies on the differential media should be gram-stained and examined microscopically. If organisms possessing the tinctorial and morphological characteristics of the *Salmonella* group are found, a culture on a plain agar slant and one on Russell's double sugar agar should be made. It may be desirable to replate for purity. The reaction in Russell's double sugar (after 24-hours' incubation) will yield preliminary evidence as to whether the culture may be a *Salmonella*. The plain agar slant culture should be preserved as stock, either at room temperature or in the refrigerator; cultures for the usual tests

may be made from either the plain agar slant or the double sugar agar slant; these include gram-staining, motility, fermentation of sugars (glucose, lactose, sucrose, mannitol, maltose, xylose, rhamnose, dulcitol, salicin, and adonitol), indole and hydrogen sulfide production; utilization of d-tartrate serves as an indication of the probable animal source of a culture. Since some of the enteric organisms may be slow in fermenting certain sugars, such as lactose and sucrose, it may be of value to seal such culture tubes by means of a cork or rubber stopper; this procedure appears to hasten the activity of a sluggish fermenter (4).

Precautions.—There are certain points of procedure the importance of which cannot be overemphasized; these are listed as follows:

(a) *Purity of cultures:* It should be remembered that all cultural tests should be made only with absolutely pure cultures. This refers not only to purity as applied to tinctorial and morphological features, but also to the fact that it is possible to be working with a mixed culture of gram-negative bacilli whose biochemical activities differ.

(b) *Period of incubation of fermentation tests:* No tests for biochemical activity should be considered negative unless they have been continuously incubated (except for observations) for a minimum of 14 days; this applies particularly to lactose, sucrose, salicin, and adonitol. Considerable embarrassment may result if a culture is reported as a nonfermenter of lactose after only 2 or 3 days' incubation.

(c) *Prevention of dissociation of cultures:* The surfaces of differential media used for isolation and of plain agar slants used for stock cultures should be free from water of condensation or syneresis; there is some evidence to indicate that cultures in continued contact with water tend to dissociate into a "rough" phase (4). The same may be true of cultures stored at 37° C. Although this dissociation may have no influence on the biochemical activities of a culture, it renders serological identification impossible in most instances. Trypaflavine, or acriflavine (neutral), in a 1:500 dilution in 0.85 percent NaCl solution will agglutinate rough cultures of *Salmonella* very rapidly in a slide test, whereas smooth cultures are unaffected (5).

(d) *Preparation of sugar media:* It is obviously essential that only C. P. sugars be used for differential fermentation tests. It must also be remembered that certain of the carbohydrates, particularly sucrose and maltose of those listed, may hydrolyze during autoclaving adequate for effective sterilization. Sugars may be conveniently prepared in aqueous solution in concentrations of 10 percent (salicin and dulcitol 5 percent), sterilized in the autoclave at 8 pounds pressure for 10 minutes, and added to the broth base (such as phenol red) under aseptic precautions to make a final concentration of 1 percent; unstable sugars should be sterilized by filtration.

SEROLOGICAL IDENTIFICATION

A *Salmonella* typing center has been established in the Department of Epidemiology, United States Naval Medical School, National Naval Medical Center, Bethesda, Md. This typing center is prepared to determine the exact identity of cultures belonging to the genus *Salmonella*. Although it may not be generally recognized, the serological classification of this group includes the typhoid bacillus and serums are available for determining its antigenic composition.

Serums for the identification of members of the so-called paracolon group serologically related to certain *Salmonellas* are also available; although the relationship of these organisms to outbreaks of gastroenteritis is not entirely clear, there is some evidence that they may be of importance (6).

The serological identification of *Salmonellas* is the outgrowth of early work by White (7), which has been confirmed and extended by Kauffmann (8) and by Edwards and his associates (1).¹

Serological typing of *Salmonellas* depends upon the determination of the somatic ("O") and flagellar ("H") antigenic composition of the organisms. The flagellar antigens may occur in one or the other, or both, of two "phases." In order to identify an organism, all antigenic factors must be determined; for example, the antigenic composition of *S. cholerae suis* is VI, VII: c : 1, 5 . . . The Roman numerals indicate the "O" factors; c indicates the phase-1 flagellar ("H") factor, and 1, 5 . . . designates the phase-2 factors present. At present there are 23 "O" antiserums and 36 "H" antiserums that are in use; these, of course, when used properly (and in conjunction with biochemical reactions when necessary) serve to identify all *Salmonellas* corresponding to known standard strains. Under existing circumstances, it is not practicable to distribute typing serums throughout the Navy; it is feasible, however, for the various field and station laboratories to make preliminary identifications by cultural and biochemical methods. When such procedures indicate that a *Salmonella* or paracolon organism has been isolated, it is strongly urged that a culture be forwarded to the naval *Salmonella* typing center, as given above, for type identification.

It is requested that when cultures are transmitted for identification the precautions listed above be strictly followed, that such cultures be made on plain agar slants, in cork or rubber stoppered tubes, with numbers (or other means of designation) clearly shown, and finally that a transcript of the cultural and biochemical observations be submitted together with pertinent data regarding the source of the culture

¹ Kauffmann is director of the International *Salmonella* Center at the State Serum Institute, Copenhagen, Denmark; Edwards is in charge of the National *Salmonella* Center at the Agricultural Experiment Station, University of Kentucky, Lexington, Ky.

(food, feces, etc.), the nature of the associated illness or condition, and other important epidemiological information. The usual official channels should of course, be used for the transmission of these materials.

A recent publication from the Connecticut State Department of Health (9) illustrates the importance of determining *Salmonella* types. One outstanding observation mentioned in this article is that 43.3 percent of all new isolations of *Salmonella* types (including the typhoid bacillus) were strains of animal origin. As stated in this paper, in many cases "the search for a human carrier as the original source of infection might prove fruitless" and "failure to apply antigenic analysis would undoubtedly have resulted in a false diagnosis of paratyphoid B infection or an incomplete diagnosis in almost one-half the cases studied."

SUMMARY

A *Salmonella* typing center has been established at the U. S. Naval Medical School which is prepared to make serological identifications of cultures isolated by field and station laboratories. Only cultures that, by means of cultural and biochemical tests carried out by the station laboratories, are tentatively identified as being *Salmonellas* or "paracolons" should be forwarded for typing. The importance of determining the exact type of *Salmonella* is discussed in relation to epidemiological procedures. Certain precautions in the handling of cultures are emphasized.

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THE SOCIAL EVIL IN JAPAN ¹

CLYDE B. CAMERER

Captain (MC) U. S. N.

and

PETER E. HUTH

Lieutenant Commander (MC) U. S. N. R.

Those who ply the "world's oldest profession" have become more active with the onset of the present war, just as they have always done in every preceding one since the dawn of history. In the more recent wars, especially World War I, every effort was made by the medical departments of all armed forces to decrease or stamp out diseases resulting from the increased activity evinced by the "*femmes de joie*" operating on all fronts.

Since the outbreak of the present conflict, the armed forces of the United States have set up venereal disease control offices under the charge of specially trained personnel, whose function is to trace all sources of infection brought to their attention through local boards of health, designed to bring *everyone* found infected under intelligent, supervised treatment until cured.

Having been fortunate in acquiring a little treatise entitled "How the Social Evil is Regulated in Japan" and published in that country some few years past, it seems timely and of passing interest to review the methods of our enemy in controlling this evil during their more peaceful days. This treatise does not aim either to defend or condemn prostitution, *per se*, but only to inform us as to how women engaged in prostitution are regarded and regulated in the Land of the Cherry Blossom.

Because the foreigner often sees the Japanese courtesan as an apparently modest and attractive woman, well dressed, carefree and happy, he is led to believe that little or no wretchedness or unpleasantness is attendant upon prostitution in Japan. But often here, as elsewhere, looks are all too deceiving!

Oriental and occidental races are separated by deep and invisible chasms in customs and languages to such an extent that occidentals simply cannot comprehend oriental psychology; hence the Japanese will often be untruthful and devoid of candor about many subjects, especially matters pertaining to their "social question." This is not due to any modesty on their part, as they converse freely among themselves and even before their women regarding such matters, which the occidental would never do. All of which, of course, renders the study of their "social evil" the more difficult for the western investigator.

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The Japanese divide their prostitutes into three general classes :

1. The *imbai* or unlicensed woman.
2. The *shogi* or licensed prostitute.
3. The *geisha* or licensed professional entertainer, singer, and dancer.

The *imbai* (sometimes known as *jigoku*, a slang expression for "street-walker") is usually heavily infected with one or more venereal diseases, as is also the case with the majority of all low-caste prostitutes, especially around the big seaports. These women are a continuation of the ancient *yo-taka*. They derive this, one of the group names (literally, "night-hawk"), from a famous house called *Yo-taka-ya* on Yoshida Street in Yeddo, the ancient name for Tokyo. They are usually referred to as "women of shameful calling."

These disfigured and diseased creatures would repair to this house and camouflage their illness and disfigurements with cosmetics and paints and then sally forth to accost their prospective customers, or rather victims, with the most brazen effrontery. Their number became so high that the Government handed over large numbers of them for confinement in the *yoshiwara* in the early part of the eighteenth century. The Government made a most determined effort to abolish these clandestine prostitutes by the enacting of very harsh laws, by which secret prostitution was punishable by forfeiture of all property, "go-downs," furniture, and other wealth, not only of the women so indicted but also of those harboring them. In addition, such culprits were manacled for 100 days and remanded to the custody of the ward police who made the necessary inspections, etc., to assure the authorities that the punishments adjudged were being properly carried out. Later, those persons guilty of hiding the offenders were punished by banishment or death, this punishment also including those ward members who were responsible for the prostitutes. A very efficient restraint of early Nipponese racketeering.

The *imbai*, or secret prostitute, has several subdivisions in this caste, as she usually combines some other business therewith, often frequenting saloons, low-caste inns, restaurants, and teahouses. Vicious married couples often entice country girls to their homes and employ them in this profession. Certain women, such as hairdressers, may act as procuresses. This type of prostitute is also known as *meshimori* and *daruma* in the country districts, from which so many are recruited. However, this type, as well as her sisters, the *shogi* and *geisha*, are found in virtually every locality throughout Japan.

The police have made earnest, but somewhat futile, efforts to stamp out the clandestine type, but there has been a steady increase in their numbers, due to industrial expansion, military and naval concentrations, and corrupt administration. Usually these women are as well, or even better, behaved than are similar classes in Europe, but like

their European sisters, are usually the victims of hordes of men and women who fatten on their earnings.

Upon entering a duly licensed brothel, a girl is required to sign an agreement with the keeper and obtain a personal license to ply her trade in a Government supervised establishment. Usually she borrows money from the keeper for current debts and agrees to comply with regulations and to make good any absence from any cause, such as a sojourn in the "lock hospital" for venereal infection, etc. No vacations are permitted by the contract, and all the burden of the tax upon a prostitute is borne by her. She also agrees to divide all earnings into two portions, one to the proprietor for room and board and other "necessary" expenses, the other half she also agrees to divide into two further portions, one of 15 percent to be paid on the principle of her loan and the remaining 35 percent is her "take" for herself. But should her earnings be insufficient to pay her living expenses, she is released from paying anything on her other indebtedness. Books are kept by both the keeper and the girl and are always subject to police scrutiny. All her clothing and other effects are mortgaged as security for her debt.

All courtesans are required by the police to report any secret information, and are likewise required to report the presence of any "wanted" person, or one appearing to have more money than his station would warrant, or anyone who may act "suspiciously." Offenders against these regulations are fined or imprisoned, or both. The proprietor might even be ordered to suspend business for various periods of time, as all principals are held responsible for the acts of their subordinates in this business.

A girl desiring to enter any particular brothel must make the usual agreement with the keeper and forward it to the police in both their names. When she desires to leave, a similar action and permission is requisite. Brothel keepers are enjoined to treat their girls fairly and endeavor to "reform" them, but should she violate any existing rules, he must report it to the police. He cannot restrain a girl from leaving his house for another, from "reforming," and marrying, etc., but prostitutes are forbidden to leave their quarters except "when there is an occasion of rejoicing or mourning in connection with grandfather, grandmother, father, mother, uncle, aunt, brothers, or sisters, or for purposes of nursing such relatives" (police regulations). They are not otherwise allowed outside the *yukaku* and cannot leave the house except for medical examinations or for important business.

The keeper must enter all financial transactions and full descriptions of his girls in books kept for the purpose, registering current fees, etc., and submit same to the police for their approval. A copy of police regulations must be displayed in a conspicuous place in the

establishment and the guests required to comply therewith. Girls in the brothel are forbidden to be "displayed, bedizened, and bedecked" to the public, but this particular regulation is modified for the *yukaku* and its inmates. Nonprostitute women are permitted in the house, but cannot "divert" themselves therein. Keepers cannot solicit business, advertise their wares, or connive with jinrikimen to bring guests to their establishment, but most of them do so surreptitiously. They are also forbidden to urge guests to eat or drink and cannot accept clothing or other valuables in lieu of cash, but must refer such matters to the police, who will adjudicate the matter after such articles are proven not to have been stolen.

Upon starting out upon her chosen career, a girl must explain why she takes this step and her statement must accompany the agreement made with the brothel keeper. These papers are duly investigated and after a thorough medical examination, the petition will be either granted or denied. Once approved, she becomes a legitimate inmate. Should she be under 20 years of age, her license will be for 3 years. When this period is completed she must return her license, and in case she elects to continue, must secure a new one. She cannot transfer from one house to another without police consent. All prostitutes are inspected by the "person" (a physician of known reliability) at some place designated by the police. Should she be ill and unable to attend, the keeper so reports and the *isha*, or doctor, is directed to visit her. Should these examinations reveal the presence of any venereal disease, hospitalization is at once instituted. Should she refrain from practicing her profession for a week or more she must be examined medically prior to resuming it. Brothel keepers are held strictly accountable for the conduct of their establishments and of the inmates, both girls and guests, and are harshly dealt with for any infractions of existing police regulations. They are legally restrained from ill-treating a girl inmate in any manner, but she cannot leave the premises unless "modestly" clothed and with the keeper's permission, and then, in addition, she must be accompanied by some person from the house, doubtless to discourage flight, etc. Should she receive a gift of money in trust from a guest, she is required to report the matter to the keeper.

Despite these many and complex rules, the courtesan is virtually at the mercy of the brothel keeper and is to all intents and purposes a slave. The law makes an effort to protect her, but custom is so strong that these girls are virtually chained to their odious profession. Profligate fathers and brothers do not shrink from sacrificing the chastity of the females in their families for their own advantage, but the sacrifice of a girl for the aid of her family apparently covers everything seemingly immoral in her conduct, and such action is regarded as heroic and highly virtuous according to the Japanese code.

Japanese law has attempted to abolish prostitution, but cannot overcome custom and the powerful opposition raised by the hordes of hangers-on, who have been too strong to overthrow and who have so far succeeded in keeping the profession active. In one of many laws, published and partially enforced, the Government argued that even though the "sale" of persons had been "forbidden from olden times" persons were "hired" for periods of time and such "hiring" actually constituted a true "sale," further, that the capital of those hiring prostitutes and singing girls being considered equivalent to stolen money, would be subject to confiscation should any complaint be made to the legal authorities. It was further held that women of this category, having lost their rights as human beings, even likening them to cattle, could not be forced to repay loans or debts due from them to their creditors. It was further stipulated that anyone causing girls to become courtesans for money under the pretext of adopting them would be severely punished.

The above laws, vague as they appear, demonstrate the illegality of the "sale" of women, but since customs are often stronger than laws, and since Japanese women have from infancy been taught to obey implicitly, it follows that they submit to these customs without objection. To the European this filial devotion of a daughter for her family is hard to believe, nor can he comprehend how parents can be so hardhearted, but the Japanese accept such sacrifices as a matter of course.

It has been held by some authorities that Japanese courtesans do not fall as low as do their Western sisters, but this is akin to comparing black to black. The Japanese quote the illustrious philosopher Confucius to defend their acts, "kill the body, but practice benevolence." However, they do not quote him when he goes on to exhort women to "Let females guard their chastity and purity!" A very convenient omission and typically Nipponese. But they circumvent this by praising her sacrifice in selling herself for the sake of her parents.

The number of women engaged in prostitution has been estimated to be well over 500,000, but when the *daruma* and *meshimori*, etc., are added, the grand total will run well over 1,000,000 to 1,500,000. Adding the *geisha* to the above, the total will soar well over the 2,000,000 mark.

Typical of rules governing the inmates of one of these "guesthouses" are those promulgated in the Kanagawara Protectorate, Tokyo:

1. No clothes can be pawned by guests.
2. No courtesan may permit intercourse except in licensed brothels and no guest may sleep with a courtesan in *hikitei-jaya* (a certain restricted area).
3. Any female not a courtesan staying in a brothel overnight must be reported to the police within 3 days, even if she is a relative or servant.

4. When an inmate runs away from a brothel, it must be reported and if and when she returns, another report is required.

5. She is permitted to leave on a doctor's order.

6. Women of *shizoku*, or noble rank, are not permitted to become prostitutes—at least legally. (This ruling is constantly evaded by the girl being “adopted” into a *heimin*, or commoner's family.)

Taxes levied on individual prostitutes have many and minute points of variation, but in total amount range from \$1 to \$3.50 (United States) per month. The houses are taxed according to the class into which they fall, varying from \$2 monthly for the lowest to \$15 (United States) for the higher classes. In Yokohama the tax on each guest in *hikite-jaya* amounts to 1 sen, 4 rin, while elsewhere it amounts to 2 sen and over (about 2 cents United States).

From all the foregoing it is made to appear that the Japanese Government makes every “apparent” effort to control prostitution. It can also be stated that this same Government has erected a most active and effective system of espionage through these houses.

A police functionary called the “Director of the Three Professions,” or *Motojime*, is in charge of the licensed houses in each prefecture. His duties comprise “stamping all documents intended for authority, keeping the inhabitants informed on government regulations, keeping a continuous journal of all activities in his quarter, maintaining a record of all prostitutes' names, advising the authorities about them, managing the affairs of the women between themselves and the hospitals, collecting taxes, informing the police of any malpractices and attending the hospital on inspection day and acting upon the doctor's orders.” Quite an assignment!

Finally, we will examine into the *geisha* or professional entertainers. These *geisha* usually live in groups. Their engagements are made through the *Kemban*, a sort of central office, which is maintained for the convenience of both the *geisha* and the public they serve. The *geisha* is usually a good-looking girl, often adopted when quite young and trained for the life she is intended to follow. Others enter the profession later in life and are usually allowed a lump sum which they use to pay off the family debts. Japanese fathers have no hesitancy in selling their pretty daughters for such a contingency.

There are three main plans under which the *geisha* works: (1) The *shichibu*, under which she pays a certain amount for living expenses and is entitled to 7 (shichi) percent of receipts after deducting for debts, interest due or money previously advanced. She furnishes her own wardrobe, much of which may be very beautiful and expensive. (2) *Sanbu* is the same, except that the girl gets but 3 (san) percent of the receipts. (3) *Nenki* is really a sort of apprenticeship for 3 to 7 years' time, during which the house provides all necessities for the

proper carrying on of her professional work. But the wary manager runs up continuous accounts of all sorts on what he expends on her, and in the end usually manages to get well repaid for his investment. The poor *geisha* is squeezed and mulcted by many clever dodges and is debited so heavily that she rarely saves any money, all her earnings going to the multitudinous grafters preying upon her profession.

There are, of course, police regulations for the *geisha* also, such as the following:

1. She must be licensed after duly notifying the police and must return her license when she retires, etc.
2. She must live in a fixed residence.
3. She must notify the police in case her guests are considered to be "suspicious" in any way.
4. There must be an absolute unavoidable "reason" for the *geisha* to be allowed to practice, and the petition must be supported by parents or relatives.

These girls, while theoretically not prostitutes, sometimes step out of their sphere as singing girls and entertainers when the "fee" is sufficiently large. Dashing young Nipponese Don Juans feel highly complimented to realize that they are the favorite of some prominent *geisha*. Some of these girls contract wealthy marriages and many are extremely clever entertainers. Their services often command a very high price.

According to Mitford, in his "Tales of Old Japan," we read of men of position who frequently choose their wives from such places as "The Three Sea Coasts," a notorious brothel, since in Japan it is of no consequence how a girl conducts herself *before* she is married, also that in Japan it is not disgraceful for respectable Japanese parents to sell their daughters in time of family adversity. These statements are not altogether correct, as only people in extreme want are prone to sell their daughters as singing girls, waitresses, or prostitutes. Occasionally a *samurai* falls the victim of some financial catastrophe and sells his daughter to this life. However, investigations have shown this to be so infrequent that such a girl in one of the houses of pleasure adds materially to its prestige.

Japanese aristocrats do not marry women of disrepute any more frequently than do Europeans. Among the lower classes, however, this does happen very frequently.

A girl is not considered disgraced if, for her parent's sake, she sells herself into the life of a "singing girl," *geisha*, or plain prostitute. It is also pointed out that this form of life becomes so distasteful to many girls that the Government has had to pass laws prohibiting a guest taking his sword or dagger into a brothel, as much for fear that one of the girls might kill herself as to maintain order among any possibly unruly guests.

Because of the many misapprehensions existing among foreign writers about prostitution in Japan, seeing it as they have in the big seaports, they have often adjudged Japanese women as unchaste. This is no more true than it would be to judge women of any other country unchaste because prostitution exists in their respective country. Actually, the difference between chastity and prostitution is much greater in Japan than in Europe, because in the former the prostitute is segregated and lives in a separate part of the city, while in Europe they freely mingle with the entire population, quite unknown to anyone and completely unmolested. In Japan the courtesans wear a special headdress and clothing, while in Europe she often dresses better than her chaste sister, especially when she is at the peak of her attractiveness.

The *yoshiwara* of old Yeddo was originally developed in the sixteenth century. A reformer, one Shogi Jinyemon, addressed the Government and had a petition granted whereby all courtesans were to be quartered in one "Flower Section," or quarter. This locality was called *Fukiya-cho* and because great quantities of rushes grew there it became known as *Yoshi wara* or "rush room." The location has been somewhat shifted with the passing of the years, but remains substantially the same since 1655. It is estimated that there are well over 10,000 inmates. This area was completely destroyed by the great fire following the earthquake of 1923, but was one of the earliest sections of Tokyo to be rebuilt.

The many teahouses scattered all over the land are really houses of assignation, it being the custom to give dinner parties in these houses, the *takimochi*, or jesters, singing girls and geishas being retained by the host for his guests' entertainment. Many of these singing girls are very popular and are not to be confused with courtesans. They are watched closely by their masters and go about in pairs or groups, thus acting as checks upon each other. However, many of them exceed their duties when monetary awards are sufficiently large and the gay young Lothario who succeeds in gaining one of these girls for his lady-love is quite proud of his prize. The usual fee paid for their entertainment is from well below \$1 (United States) and up per hour, along with the usual presents given them.

The masters of these girls usually buy them when they are quite young and see that they are carefully educated for the vocation they are to follow. It is obvious that once these women are past the bloom of youth they become a liability instead of an asset, hence they are engaged for only a brief period. Courtesans are usually bought for the time until they reach the age of 27 years, singing girls until the age of 30. Upon attaining these respective ages, they again become "their own property."

Children who are selected for training as singing girls are bought when about 5 or 6 years of age, the price averaging around from \$8 to \$12 (United States). The purchasers educate these youngsters and bring them up as and with their own children. The parents are required to sign a waiver covering sickness and accidents, which absolves the purchaser from all responsibility in these respects. But the parents are aware that they have no occasion for worry regarding such eventualities, since they know that the health of their little ones is a material asset to the quasi-foster parent. Older girls who are sufficiently trained and show special aptitude for their prospective professions command considerably higher prices.

Whenever a girl is purchased to become a prostitute she commands the same general price as does one designed for the career of a singing girl. After purchase and the usual formalities attendant thereon, she is attached to the entourage of some fashionable courtesan, or *oiran*, and acts in the capacity of a *kamura*, or female page. These little girls usually come from hard-pressed families or are orphans, whose relatives prefer selling them into this life rather than bearing the financial burden of raising them to normal young womanhood. Older girls usually come from this same class or from the ranks of those girls who sell their bodies in filial devotion to indigent parents, or even certain married women, who thus attempt to meet their husbands' wants. Another small group stem from those girls who have been seduced and abandoned by their lovers.

After nightfall the women of the *yukaku* leave their tiny rooms, where they have been sleeping and beautifying themselves for the night's ordeal, and take their places in the narrow, wooden, cage-like structure before their respective houses, where they sit perfectly still until they have attracted the attention of passers-by who throng the streets before them. Before these girls make their appearance, they paint their lips, cheeks, and eyebrows and render their throats and bosoms snowy white. The hair is meticulously dressed, with the three points where the head joins the neck accentuated, all in an effort to meet the demands of Japanese beauty. In some more sophisticated sections, the portraits only of the courtesans are exhibited, from which the prospective customer chooses. This procedure, it is claimed, insures the entry into the house of the prospect, with a better opportunity of extracting money from him.

In the big seaports these women of the *yukaku* may be heard loudly importuning their prospective customers to enter, often in most atrocious, blasphemous, "pidgin" language, which has been picked up from foreign visitors from the ends of the earth. One hears some most startling and picturesque expressions. But in the Tokyo *yoshiwara*, where the great majority of the clientele is Nipponese, as in other inland cities and towns, the greatest decorum is observed,

vice continuing at peak capacity, yet as unobtrusive and decorous as the most exacting custom could require. A most punctilious and polite people, the Japanese, even in such very intimate matters.

It is customary for the courtesans to take an assumed name upon entry into their professional work. These names all attempt to indicate beauty and desirability and at the same time to hide the odious nature of their employment. Frequently such appellations as "Little Pine," "Little Butterfly," "Jewelled Rivers," "Gold Mountain," "The Stork Living for a Thousand Years," "Forest of Cherries," "Little Chrysanthemum," etc., are often encountered, as well as many others.

The *geisha* is always accomplished in music in all its forms, as enjoyed in Japan, and as an entertainer ranks between the professional actress, or *yakusha*, and the *yoro-ya*, or prostitute. These girls contribute largely to their city's revenue, as they are heavily taxed. The *geisha* is likewise frequently employed to entertain guests in respectable teahouses with her music, singing, and pantomime, or those whose means permit often employ her to entertain their families and guests at dinner parties, etc. Many of these girls are really beautiful, according to any standards, very witty and versed in pantomime and music, as well as the art of being agreeable and companionable. With the consent of their managers and for a price, these *geisha* may be engaged to any native Japanese or to a foreigner for periods of a month or longer to act as "private entertainers," hence "Madame Butterfly" and kindred tales.

In summation, following this rather rambling and disjointed presentation of things Japanese in re their social evil, it may be stated that the Jap makes no bones of such matters, is perfectly frank about it and sees nothing degrading to his womankind or himself by his conduct and management of such matters as are usually taboo in Western circles. He has no regard or reverence for woman as has the Westerner and is to be considered as unmoral, rather than immoral, according to our standards. It is related that his unique but highly effective way of dispossessing Christian missionaries in Korea was to establish promptly a full-crewed *yoshiwara* immediately adjacent to the mission. With the removal of the missionaries elsewhere, they would again be confronted with the same situation, this continuing until the missionaries in final despair and defeat left the field to the wily Oriental and his evil ways.

It is also customary for the authorities to provide the armed forces with details of prostitutes, and the tales of women being captured in the South Pacific area with Japanese troops illustrates this custom and does not signify that the Japanese are using women as soldiers in any sense, those captured being merely some of these unfortunate *mausmes* who have accompanied the troops in their spread to the south.

STATISTICS

DISEASES CAUSING SURVEY.....	1199

The following table was prepared from reports of medical surveys received in the Bureau during January and February 1943, in which disabilities or disease causing the survey were noted existing prior to entry into the Navy. With certain diseases, survey followed entry so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Abscess, cornea	1	Anomaly, congenital, dia-	
Abscess, periapical	5	phragm	1
Absence, acquired, bony substance, skull	2	Aphakia	2
Absence, acquired, distal phalanges, index and middle finger, right hand	1	Arteriosclerosis, cerebral	2
Absence, acquired, cervical meniscus	1	Arteriosclerosis, general	10
Absence, acquired, ligament, knee	1	Arteriosclerosis, local	2
Absence, acquired, teeth	61	Arthritis, acute	1
Absence, congenital, right pectoralis muscle	1	Arthritis, chronic	264
Absence, congenital, spinal processes of eleventh and twelfth dorsal vertebrae	1	Asthma	224
Achylia gastrica	1	Astigmatism, compound hyperopic	8
Acne, cystic, face	1	Astigmatism, compound myopic	12
Acne vulgaris	7	Astigmatism, mixed	12
Adenocarcinoma, rectum	1	Astigmatism, simple hyperopic	2
Adenoiditis, chronic	1	Astigmatism, simple myopic	2
Adhesions, abdominal	5	Ataxia, hereditary	1
Adhesions, arachnoid	1	Atrophy, brain	1
Adhesions, periarticular, shoulder	1	Atrophy, cerebral	2
Adhesions, peritoneal	1	Atrophy, leg	3
Adhesions, left pleural cavity	1	Atrophy, muscle	7
Adhesions, skin and muscle, right femur	1	Atrophy, nerve	1
Albuminuria	29	Atrophy, optic nerve	6
Alcoholism, chronic	17	Atrophy, shoulder	1
Allergy	9	Atrophy, testes	1
Amblyopia	78	Blepharitis	4
Angina pectoris	7	Blindness, unilateral	2
Angioneurotic edema	4	Bromidrosis	1
Ankylosis	6	Bronchiectasis	22
		Bronchitis, asthmatic	1
		Bronchitis, chronic	4
		Bursitis, chronic	4
		Calculus, kidney	4
		Calculus, renal	5
		Calculus, ureter	1
		Calculus, urethral	1
		Callosity	1

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Carcinoma.....	1	Defective physical development.....	5
Cardiac arrhythmia, auricular fibrillation.....	1	Deficient vision.....	2
Cardiac arrhythmia, heart block.....	2	Deformity, acquired.....	220
Cardiac arrhythmia, paroxysmal tachycardia.....	8	Deformity, congenital.....	106
Cardiac arrhythmia, premature contractions.....	3	Dementia paralytica.....	2
Cardiac disorder, functional.....	7	Dementia praecox.....	191
Cardiospasm.....	1	Dermatitis.....	6
Caries, teeth.....	15	Dermatitis, atopic.....	4
Cataract.....	10	Dermatitis, neurogenous.....	1
Cataract, congenital.....	2	Deviation, nasal septum.....	1
Cataract, traumatic.....	1	Diabetes insipidus.....	2
Cerebrospinal syphilis, undifferentiated.....	5	Diabetes mellitus.....	22
Chilblain.....	1	Dislocation, articular cartilage.....	16
Cholangitis, chronic.....	1	Dislocation, chronic, recurrent.....	18
Cholecystitis, chronic.....	6	Dislocation, intervertebral disc.....	1
Cholelithiasis.....	3	Dislocation, joint.....	3
Chorea.....	2	Diverticulum, bladder.....	1
Chorioretinitis.....	14	Diverticulum, duodenum.....	1
Choroiditis.....	6	Diverticulum, intestinal.....	1
Cicatrix, skin.....	11	Diverticulum, stomach.....	1
Coarctation of aorta.....	1	Duodenitis.....	11
Colitis, chronic.....	8	Dysinsulinism.....	6
Colitis, ulcerative.....	6	Dystrophy, progressive.....	2
Color blindness.....	2	Eczema.....	22
Constitutional psychopathic inferiority with psychosis.....	3	Effort syndrome.....	27
Constitutional psychopathic inferiority without psychosis.....	122	Emphysema, pulmonary.....	6
Constitutional psychopathic state, criminalism.....	2	Encephalopathy, post-traumatic.....	3
Constitutional psychopathic state, emotional instability.....	359	Endarteritis, legs.....	2
Constitutional psychopathic state, inadequate personality.....	237	Endocrinopathy, hypogonadism.....	1
Constitutional psychopathic state, pathological liar.....	2	Endocrinopathy, hypopituitary.....	1
Constitutional psychopathic state, paranoid personality.....	14	Endocrinopathy, obesity.....	1
Constitutional psychopathic state, schizoid personality.....	3	Endocrinopathy, pluriglandular.....	1
Constitutional psychopathic state, sexual psychopathy.....	20	Enuresis.....	102
Contracture.....	7	Epididymitis, chronic, non-venereal.....	2
Coronary heart disease, arteriosclerotic.....	19	Epidermolysis bullosa.....	1
Cryptorchidism.....	25	Epilepsy.....	220
Curvature, spine.....	17	Epilepsy, Jacksonian.....	6
Cyst, benign.....	1	Epiphora.....	1
Cyst, dermoid.....	1	Epiphysitis, left femur.....	1
Cyst, congenital, lungs.....	3	Epiphysitis, right fifth metatarsal.....	1
Cyst, pulmonary, congenital.....	1	Epiphysitis, vertebra.....	7
Cyst, quiescent.....	2	Epithelioma, lip.....	2
Cyst, teratoma, inflamed.....	2	Erythema multiforme.....	1
Cystitis, chronic, nonvenereal.....	1	Erythema nodosum.....	1
Dacryocystitis.....	1	Erythromelalgia.....	1
Deafness, bilateral.....	68	Favus.....	1
Deafness, unilateral.....	44	Fibroma, left buttock.....	1
		Fibroma, right pleura.....	1
		Fibroma, mediastinum.....	1
		Fibrosis, pulmonary, interstitial.....	1
		Fistula, urethral.....	1
		Flat foot.....	368
		Focal infection, teeth.....	1
		Foreign body, traumatic.....	4
		Foreign body, nontraumatic.....	1
		Fracture, compound.....	2
		Fracture, simple.....	12

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Fungus infection, skin	2	Intracranial injury, old	49
Furunculosis	1	Intraspinal injury	2
Gastritis, chronic	23	Iridocyclitis	2
Gastritis, hypertrophic	1	Irritable colon	6
Gastroduodenitis	5	Iritis, recurrent	1
Genu recurvatum	1	Jaundice, hemolytic	1
Genu valgum	3	Joint, internal derangement of	150
Glaucoma	2	Keloid	2
Glycosuria	2	Keratitis	3
Goiter, exophthalmic	4	Keratoses	1
Goiter, adenomatous	2	Kienböck's disease	1
Gonococcus infection, joint	1	Laryngitis, chronic	1
Gonococcus infection, prostate	9	Lipoma, multiple	2
Gout, acute	1	Loose body in joint	3
Gout, chronic	3	Loss of substance of bone	6
Hallux valgus	7	Lupus erythematosus	1
Hammertoe	6	Lymphangiectasis, right lower extremity	1
Hay fever	3	Lymphoma, mediastinal	1
Headache	13	Lymphosarcoma, spinal cord	1
Head syndrome, post-traumatic	2	Mastoiditis, chronic	11
Heart disease, congenital	11	Masturbation	1
Hematoma, subdural, chronic, traumatic	2	Melancholia, involutional	1
Hematuria	1	Meniere's disease	1
Hemianopsia	1	Mental deficiency, moron	63
Hemiplegia, old	1	Metatarsalgia	19
Hemoglobinuria	1	Migraine	31
Hemoptysis	1	Myocarditis, chronic	14
Hemorrhage, stomach	1	Myofascitis, chronic	11
Hemorrhoids	10	Myopia	55
Hepatitis, chronic	2	Myositis, chronic	133
Heredofamilial tremor	1	Myotonia atrophica	1
Hernia, epigastric	3	Narcolepsy	1
Hernia, diaphragmatic	1	Necrosis, ulna and radius	1
Hernia, inguinal, direct	13	Necrosis, femur	1
Hernia, inguinal, indirect	78	Nephritis, chronic	21
Hernia, nucleus pulposus	1	Nephroptosis	5
Hernia, recurrent, after operation	16	Neuralgia	3
Hernia, umbilical	2	Neuritis, eighth nerve	1
Hernia, ventral	8	Neuritis, external saphenous nerve	1
Herpes zoster	1	Neuritis, multiple	2
Hodgkin's disease	1	Neuritis, optic	6
Hydrocele	1	Neuritis, sciatic	16
Hydronephrosis	4	Neurocirculatory asthenia	2
Hyperhidrosis	1	Neuroretinitis	1
Hyperopia	4	Neurosis, cardiac	2
Hypertension, arterial	112	Neurosis, gastric	17
Hypertensive heart disease	17	Neurosis, intestinal	17
Hyperthyroidism	5	Neurosis, stomach	1
Hypertrophy, bone	2	Neurosyphilis, serological	4
Hypertrophy, heart	1	Night blindness	3
Hypochondriasis	10	No disease (maladjustment to Naval service)	2
Hypopituitarism	2	No disease (muscular rheumatism)	1
Hypotension, arterial	2	Nystagmus	3
Hypothyroidism	9	Obesity	1
Ichthyosis	6	Obstruction, intestinal	4
Incontinence, feces	1	Opacity, cornea	1
Incontinence, urine	1	Orchidalgia	1
Insufficiency, ocular muscle	2		

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Orchitis, chronic	1	Psychosis, manic depressive	40
Osgood-Schlatter disease	5	Psychosis, unclassified	21
Ossification, ligament, right knee	1	Psychosis with organic brain disease	1
Ossification, ligament, right shoulder	1	Psychosis with other disabilities (mental deficiency)	2
Ossification, medullary canal, right ulna	1	Psychosis with other disabilities (psychopathic inferiority)	1
Osteoarthropathy, hypertrophic	6	Psychosis with psychopathic personality	3
Osteoarthropathy, pulmonary, chronic	1	Ptosis	3
Osteochondritis deformans	11	Pyelitis, chronic	3
Osteochondritis dissecans	17	Pyelonephritis	5
Osteochondroma, right fibula	2	Pylorospasm	2
Osteochondroma, left femur	1	Ravnaud's disease	4
Osteochondroma, left tibia	3	Retinitis	7
Osteochondromatosis	4	Rheumatic fever	14
Osteoma	5	Rheumatism, muscular	7
Osteomalacia	1	Rhinitis, atrophic	2
Osteomyelitis, chronic	14	Rhinitis, hypertrophic	1
Otitis media, chronic	103	Rupture, traumatic	14
Otosclerosis	1	Rupture, nucleus pulposus	1
Pansinusitis	13	Sclerosis, disseminated	5
Papillitis	3	Seasickness	2
Paradentosis	13	Senility	1
Paralysis agitans	4	Severe funnel chest	1
Paralysis, nerve	16	Sexual perversion	9
Paralysis, ocular muscle	3	Silicosis	5
Paranoid state	3	Simple adult maladjustment	3
Perforated nasal septum	5	Sinusitis, ethmoidal	5
Perforation, ear drum	2	Sinusitis, maxillary	6
Pes cavus	37	Snapping hip, bilateral	1
Pes planus	2	Snoring	1
Phlebitis	25	Somnambulism	15
Pleurisy, fibrinous, chronic	25	Splenitis	1
Pleurisy, serofibrinous	2	Spondylitis	20
Pneumoconiosis	1	Spondylolisthesis	5
Pneumonitis, chronic, nontubercular	13	Sprain	16
Pneumothorax	1	Spur, bone	6
Poliomyelitis, anterior, chronic	3	Strabismus	6
Postural defect, spine	3	Stammering	4
Proctitis	1	Strain	7
Prostatitis, chronic, non-venereal	9	Stricture, esophagus	1
Psoriasis	4	Stricture, urethra	7
Psychoneurosis, anxiety neurosis	113	Sycosis	3
Psychoneurosis, compulsion neurosis	3	Syncope	6
Psychoneurosis, epileptic	2	Synechia	2
Psychoneurosis, hysteria	85	Synovitis, chronic	14
Psychoneurosis, mixed	1	Syphilis	31
Psychoneurosis, neurasthenia	68	Syphilis, seropositive only	14
Psychoneurosis, situational	18	Tachycardia	21
Psychoneurosis, traumatic	21	Talipes	5
Psychoneurosis, unclassified	64	Tenosynovitis, chronic	1
Psychosis, epileptic	5	Teratoma, testicle	2
Psychosis, intoxication, alcoholic	5	Thrombo-angiitis obliterans	11
		Thrombosis, coronary	1
		Thrombosis, femoral vein	1
		Thrombosis, axillary vein	1
		Thyroiditis, chronic	1
		Tic	1

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Tracheobronchitis, chronic----	4	Urticaria-----	5
Trichinosis-----	1	Uveitis-----	1
Tuberculosis, general miliary--	2	Valvular heart disease, aortic and mitral-----	40
Tuberculosis, pulmonary, acute, pneumonic-----	1	Valvular heart disease, aortic insufficiency-----	14
Tuberculosis, pulmonary, chronic, active, advanced----	96	Valvular heart disease, aortic stenosis-----	4
Tuberculosis, pulmonary, chronic, arrested-----	293	Valvular heart disease, mitral insufficiency-----	90
Tuberculosis, pulmonary, primary, healed-----	45	Valvular heart disease, mitral stenosis-----	60
Tuberculosis, juvenile, arrested--	2	Valvular heart disease, pulmonary-----	2
Tumor, mediastinal-----	2	Varicocele-----	1
Tumor, mixed-----	10	Varicose veins-----	40
Ulcer, duodenum-----	272	Von Recklinghausen's disease--	1
Ulcer, gastric-----	2	Wound, gunshot-----	4
Ulcer, skin-----	1	Xeroderma pigmentosa-----	1
Ulcer, stomach-----	38		
Ulcer, varicose, leg-----	1		
Undulant fever-----	3		
Union of fracture, faulty-----	68		
Urethritis, chronic, nonvenereal--	1	Total-----	6,707

NOTES ON OUR RESERVE CONTRIBUTORS

Armentrout, Charles H., Lieutenant (MC) U. S. N. R. (*Treatment of Cerebrospinal Fever, Meningococcic*, p. 973). M. D., Medical College of Virginia, 1931. Intern, Medical College of Virginia, 1931-32; graduate assistant, medicine, Massachusetts General Hospital, Boston, 1930-40; consulting staff, Biltmore Hospital, Biltmore, N. C.; staff, Aston Park Hospital, Asheville, N. C. Member American Medical Association; associate American College of Physicians; American Board of Internal Medicine; Association of Military Surgeons.

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Brown, Herbert R., Jr., Lieutenant (MC) U. S. N. R. (*Single Unit Emergency Plasma Procuring and Donor Apparatus*, p. 1144). A. B., Harvard University, 1934; M. D., University of Rochester School of Medicine and Dentistry, 1939.

Intern, medicine, 1939-40; assistant resident, medicine, 1940-41; resident, fever therapy and neurology, 1941-42. Instructor in medicine (on leave) 1942, Strong Memorial and Rochester Municipal Hospitals, University of Rochester. American Medical Association; American Federation of Clinical Investigation.

Buchstein, Harold F., Lieutenant Commander (MC) U. S. N. R. (*Pyogenic Spinal Epidural Infections*, p. 1114). A. B., M. D., M. S., University of Minnesota. Fellow in neurosurgery, Mayo Foundation, 1935-38; honorary research fellow, Yale University, 1939; clinical instructor, neurosurgery, University of Minnesota, 1939; consulting neurosurgeon, Minneapolis General Hospital, 1939-. American College of Surgeons; Minnesota Society of Neurology and Psychiatry.

Coburn, Alvin F., Lieutenant Commander (MC) U. S. N. R. (*Epidemiology of Streptococcus Hemolyticus Infections at Naval Training Stations*, p. 1012). Phillips Andover, 1917; Yale, 1921; Johns Hopkins, 1925. Associate professor of medicine, Columbia University; attending at Presbyterian-Columbia Medical Center, St. Vincent's and Grasslands Hospitals. Member American Society for Clinical Investigation; Association of American Physicians; American Association for the Advancement of Science. Author, *The Factor of Infection in the Rheumatic State*, 1931.

Correll, Howard L., Lieutenant (MC) U. S. N. R. (*Primary Atypical Pneumonia*, p. 980). B. S., 1930; M. D., University of Wisconsin, 1935. Intern, Ancker Hospital, St. Paul, 1935-36; resident in medicine, State University of Iowa Hospital, 1936-37; senior resident in neuropsychiatry, Wisconsin General Hospital, 1937-38; resident in internal medicine, Milwaukee City General Hospital, 1938-40; private practice, internal medicine, Milwaukee, 1940-41. American Medical Association; American Heart Association.

Cowan, Irving I., Lieutenant (MC) U. S. N. R. (*Primary Atypical Pneumonia; an Analysis of Therapeutic Results in 155 Cases*, p. 980). B. S., University of Pittsburgh, 1927; M. D., Vanderbilt University Medical School, 1931. Resident X-ray Department, Mount Sinai Hospital, New York City, 1934-36; director, X-ray Department, Mount Sinai Hospital, Milwaukee, Wisconsin, 1936-42; clinical instructor, roentgenology, Marquette University Medical School, 1937-42. Member American Medical Association; Milwaukee Roentgen Ray Society, Radiological Society of North America; diplomate American Board of Radiology; American College of Radiology.

Dillenberg, Stanley M., Lieutenant Commander (MC) U. S. N. R. (*Neuropsychiatric Clinic at a Naval Construction Training Center*, p. 1076). B. S. University of Pennsylvania Medical School; M. D. 1932. Instructor, neurology and neuroanatomy, Physicians and Surgeons College, Columbia University, 1935-42; resident neurologist, Neurological Institute of New York, 1933-35; neurologist, Neurological Institute of New York, Lenox Hill Hospital, New York, and Welfare Hospital, New York. Member New York Neurological Society; New York State and County Medical Societies; American Medical Association.

Godfrey, Ellwood W., Lieutenant (MC) U. S. N. R. (*Pneumohydropericardium*, p. 1001). M. D., University of Pennsylvania Medical School, 1937. Intern, Bryn Mawr Hospital, 1938; fellowship in radiology, radiology department, University of Pennsylvania Hospital, 1938-41. Associate instructor in radiology, Graduate School of Medicine, University of Pennsylvania, 1938-41; associate instructor in radiology, University of Pennsylvania, 1938-41; instructor, 1941. Diplomate of the American Board of Radiology, 1941; member American Medical Association; American College of Radiology.

Goodale, Raymond H., Commander (MC) U. S. N. R. (*Studies on the Improvement of Wound Therapy by the Use of Synergistic Mixtures of Antibacterial Substances*, p. 1057). B. S., Wesleyan University, 1920; M. D., Harvard University Medical School, 1924. Adjunct professor of pathology, American University, Beirut, Syria, 1926-29; associate pathologist, City Hospital, Worcester, Mass., 1929-31; pathologist since 1931; assistant professor experimental pathology, Boston University School of Medicine, 1935-. Author, Interpretation of Laboratory Findings, 1936. Member American Medical Association; American Board of Pathology; American Association of Pathologists and Bacteriologists; New York Pathological Society.

Haight, Warne L., Lieutenant Commander (MC) U. S. N. R. (*Primary Atypical Pneumonia, Etiology Unknown*, p. 988). M. D., Jefferson Medical College, 1931. Intern, Jefferson Medical College Hospital, June 1931-September 1933; director of laboratories, Warne Hospital and Clinic, Pottsville, Pa., 1934-41; electrocardiologist, 1938-; first surgical assistant to chief surgeon, 1933-. Schuylkill County Medical Society; Pennsylvania State Medical Society.

Halprin, Harry, Lieutenant Commander (MC) U. S. N. R. (*Dissecting Aneurysm of the Entire Aorta with Partial Bilateral Renal Artery Occlusion*, p. 1098). M. D., University and Bellevue Hospital Medical College, 1923. Intern and resident physician, Mountainside Hospital, Montclair, N. J., 1923-25. Associate attending in medicine, Mountain Hospital; Chief, cardiac clinic, Mountainside Hospital; consulting cardiologist, Montclair Community Hospital; consulting cardiologist, Essex County Isolation Hospital. Member American Medical Association; Associated Physicians of Montclair and Vicinity; Essex County and New Jersey State Medical Society; American Heart Association; fellow American College of Physicians.

Huth, Peter E., Lieutenant Commander (MC) U. S. N. R. (*The Social Evil in Japan*, p. 1189). B. S., Georgetown University, 1919; M. D. 1923. Associate in urology to Dr. Robert W. McKay, 1935-38; attending urologist, Tuomey Hospital, Sumter, S. C.; consulting urologist, Camden Hospital, Camden, S. C. Member American Medical Association; American Urological Association; Southeastern Section American Urological Association; South Carolina Urological Association; American Board of Urology; State and county medical societies.

James, Arthur P. R., Lieutenant Commander (MC) U. S. N. R. (*The Fungi Go to War*, p. 1065). M. D., Toronto University (Canada), 1926. Dermatologist, St. Vincent's, Mercy, Flower, Lucas County General, Robinwood, and Toledo hospitals, Toledo, Ohio; director, skin and syphilis clinics, City of Toledo and St. Vincent's Hospital. Diplomate American Board of Dermatology and Syphilology; fellow American Academy of Dermatology; member Society for Investigative Dermatology; Detroit Dermatological Society.

Kern, Richard A., Captain (MC) U. S. N. R. (*Pneumohydropericardium*, p. 1001). A. B., University of Pennsylvania, 1910; M. D., 1914. Instructor, medicine, University of Pennsylvania, 1916-21; associate, University of Pennsylvania School of Medicine and Graduate School of Medicine, 1921-28; assistant professor, 1928-34; professor, clinical medical, 1934-; assistant physician, University Hospital. American Medical Association; associate American Physicians; American Society for Clinical Investigation; Society for the Study of Asthma (president, 1934); American Clinical and Climatological Association; American College of Physicians; American Association for the Study of Allergy (president, 1931); College of Physicians of Philadelphia; Pathological Society of Philadelphia.

- Kolb, Lawrence C.**, Lieutenant (MC) U. S. N. R. (*Combat Fatigue and War Neurosis*, p. 923). B. A., Trinity College, Dublin University, 1932; M. D., School of Medicine, Johns Hopkins University, 1934. Intern, medicine and surgery, Strong Memorial Hospital, Rochester, N. Y., 1934-36; fellow, 1936-40; instructor in neurology, School of Medicine, Johns Hopkins University, 1940-41; assistant dispensary neurologist, Johns Hopkins Hospital, 1936-41; assistant visiting neurologist, Baltimore City Hospital, 1936-41; John and Mary Markle fellow in neurology, National Hospital, London, England, 1938-39; resident psychiatrist, Milwaukee Sanitarium, 1941-42. Baltimore City Medical Society; Society of Neurological Physiology. Certified, American Board of Neurology and Psychiatry, 1941-42. Coauthor, *Physiology of Micturition*, Wm. Wood & Co., 1940.
- Lebensohn, James E.**, Commander (MC) U. S. N. R. (*Impacted Cerumen*; p. 1071). B. S., University of Chicago, 1914, and M. S., 1915; M. D., Rush Medical College, 1917; Ph. D., Northwestern University, 1935. Ophthalmologist and otolaryngologist, United States Veterans' Hospital, Ill., 1921-24; assistant professor, ophthalmology, Northwestern University Medical School, 1929-. Attending ophthalmologist, Mount Sinai Hospital, Chicago, 1921-; Cook County Hospital, 1937-; associate ophthal. surgeon, Illinois Charitable Eye and Ear Infirmary, 1925-37; visiting ophthalmologist, Frances Willard Hospital, 1921-. A. A.; American Academy of Ophthalmology and Otolaryngology; American Medical Association; fellow American College of Surgeons; Chicago Ophthalmological Society; Chicago Society for the History of Medicine; corresponding member Mexican Ophthalmological Society.
- Levinson, Seymour**, Lieutenant, junior grade H-V (S) U. S. N. R. (*Determination of Turpentine in Air*, p. 1138). B. S., College of the City of New York, 1936-40; graduate work, George Washington University, 1940-41. Chemist, Washington Navy Yard, 1941-42.
- Locke, Bernard**, Lieutenant H-V(S) U. S. N. R. (*Neuropsychiatric Clinic at a Naval Construction Training Center*, p. 1076). B. S., 1933; Ph. D., New York University, 1941. Director, Psychological Clinic, Neurological Hospital, Welfare Island, N. Y., 1935-36; psychologist, Mental Hygiene Clinic, Kings County Hospital, 1936-38; mental hygiene consultant, Board of Child Welfare, New York City, 1938-40; psychologist, Clinton Prison, Dannemora, N. Y., 1939-; research psychologist, Mayor LaGuardia's Committee on Marihuana, 1940. American Psychological Association.
- Master, Arthur M.**, Commander (MC) U. S. N. R. (*Rheumatic Fever in the Navy*, p. 1019). B. S., College of the City of New York, 1916; M. D., Cornell, 1921. Cornell traveling fellow, University Col. Hospital Medical School, London, 1924-25; adj. physician, Mount Sinai Hospital, New York, 1928-34; cardiographer, 1933; associate in medicine, 1934-41; electrocardiographer, clinic, medical college, Cornell, 1927-32. Cardiac consultant, U. S. Veterans' Hospital No. 81, 1927-28; cardiologist, Joint Disease Hospital, 1927-30; chief cardiac clinic, New York Hospital, 1928; assistant cardiographer, 1927-32; physician, outpatient department, 1933-41; assistant professor, clinical medicine, Columbia University, 1939-41. Member A. A.; American Medical Association; American College of Physicians; Society for Experimental Biology; Harvey Society; New York Academy of Medicine; New York Path. Society. Author, *Electrocardiogram and X-ray Configuration of Heart*, 2d edition, 1942.
- McMaster, Paul E.**, Lieutenant Commander (MC) U. S. N. R. (*Orthopedic Conditions Requiring Medical Survey Among Marine Recruits*, p. 1041). M. D., Rush Medical College, 1928. Assistant and instructor, orthopedic surgery, University of Chicago, 1930-33; instructor and assistant clinical professor, orthopedic

surgery, University of Southern California Medical School, 1933-. Diplomate American Board of Orthopedic Surgery, 1938; member American Academy of Orthopedic Surgeons; Western Orthopedic Association.

Mourot, Arthur J., Lieutenant Commander (MC) U. S. N. R. (*The Late Treatment of Flash Burns*, p. 953). B. S., University of West Virginia, 1929; M. D., New York University and Bellevue Hospital Medical School, 1931. Intern, Bellevue Hospital, 1932-34; clinical instructor, surgery, George Washington University, 1936-41; attending surgeon, Gallinger Hospital and George Washington University Hospital, 1936-41; surgeon, Chesapeake & Ohio Railway Co., Southern Railway, and Richmond, Fredericksburg & Potomac Railroad Co. Member District of Columbia Medical Society.

Newcomer, William, Lieutenant (MC) U. S. N. R. (*A Summary of 50 Cases of Cerebrospinal Fever, Meningococcic*, p. 966). M. D., Medical College of Virginia, Richmond, Va., 1930. Resident, staff, Baltimore City Hospital, Baltimore, Md., 1930-32; assistant medical director, Hospital for Consumptives of Maryland, Towson, Md., 1932-42. Member American Medical Association; American College of Chest Physicians; American Trudeau Society.

Patterson, John K., Commander (MC) U. S. N. R. (*Practical Devices Evolved and Used in a Combat Area*, p. 1127). B. A., Reed College, 1925; M. D., Harvard Medical School, 1929. House surgeon, Roosevelt Hospital, New York City, 1930-32; house gynecologist, 1932; house physician, Boston Lying-in Hospital, 1933; resident, obstetrics-gynecology, Doctors Hospital, New York City, 1933-35; private practice, obstetrics and gynecology, Santa Barbara, Calif., 1935-41; chief of obstetrics-gynecology service and chief staff, St. Francis Hospital, Santa Barbara, Calif. Member American Medical Association; Santa Barbara Medical Society; Los Angeles Obstetric-Gynecology Society; American Committee on Maternal Welfare, International College of Surgeons.

Robins, Arthur M., Lieutenant (MC) U. S. N. R. (*A Comparative Study of Chest X-ray Survey Methods*, p. 1036). M. D., College of Physicians and Surgeons, Columbia University, 1931; Med. Sc. D., Columbia University, 1935; Dr. P. H., Yale University, 1942. Intern, Bellevue Hospital, 1931-32; intern, pathology, Presbyterian Hospital, New York City, 1932-33; resident physician, tuberculosis, Bellevue Hospital, 1933-36; supervisor of clinics, Bureau of Tuberculosis, Department of Health, New York City, 1937-. Member American Medical Association; American Trudeau Society; American Public Health Association; American Industrial Hygiene Association.

Rumble, Edmund T., Jr., Lieutenant (MC) U. S. N. R. (*Tank Casualty*, p. 1123). B. S., Hamilton College, 1931; M. D., College of Physicians and Surgeons, Columbia University, 1935. Rotating internship, Brooklyn, N. Y., July 1935-July 1937; resident, surgery, Midwood Hospital, Brooklyn, N. Y., September 1937-June 1938; private practice, Cohecton, Sullivan County, N. Y., July 1938-. American Medical Association; Sullivan County Medical Society; New York State Health Officers' Association.

Shackford, Bartlett C., Commander (MC) U. S. N. R. (*Errors in Iso-Agglutination Tests*, p. 1078). S. B., Dartmouth College, 1917; M. D., Harvard Medical School, 1919. Instructor, histology, Dartmouth Medical School, 1919-20; first assistant in pathology, Boston (Mass.) City Hospital, 1920-21; pathologist, Decatur (Ill.) and Macon County Hospital, 1921-25; pathologist, Long Beach (Calif.) Community and St. Mary's Hospital, 1926-43; San Pedro General Hospital, 1941-43. American Board of Pathology; American Society of Clinical Pathologists; American Heart Association; California Heart Asso-

ciation; Los Angeles County and California State Medical Associations; American Medical Association.

Spangler, Paul E., Commander (MC) U. S. N. R. (*Islet Cell Adenoma of the Pancreas Associated with Bilateral Urinary Calculi*, p. 1087). A. B., University of Oregon, 1919; M. D., Harvard Medical School, 1923. Surgical house pupil, Massachusetts General Hospital, 1923-25; resident surgeon, New York Lying-In Hospital, 1925; associate surgeon, Robert C. Coffey Clinic and Hospital, 1926-33; chief surgeon, Robert C. Coffey Clinic and Hospital, 1933-34; chief of surgery, Coffey Memorial Hospital, 1939-41.

Stabins, Samuel J., Lieutenant Commander (MC) U. S. N. R. (*Primary Thrombosis of the Axillary Vein Due to Strain*, p. 1106). M. D., Emory University School of Medicine, 1925. Intern, New Haven Hospital, 1925-26; surgical pathology, Yale University Medical School, 1926; surgeon-in-charge, Experimental Animal Laboratory, University of Rochester School of Medicine and Dentistry, 1926-27; assistant in surgery, University of Rochester School of Medicine and Dentistry, and assistant resident surgeon, Strong Memorial Hospital, 1927-28; instructor, surgery, and resident surgeon, Strong Memorial Hospital, 1928-29; instructor, surgery, University of Rochester School of Medicine and Dentistry, 1929-35; assistant professor of surgery, 1935-. American Board of Surgery; president Society of University Surgeons, 1939-40.

Stedman, Harold E., Commander (MC) U. S. N. R. (*The Local Use of Microcrystalline Sulfathiazole in the Treatment of Female Gonorrhea and as a Prophylaxis for Gonorrhea*, p. 1118). M. D., University of Michigan, 1928. Private practice, Englewood, N. J., 1930-34; Englewood Hospital, Englewood, N. J., 1930-34; Nassau Hospital, Mineola, N. Y., 1940-; Meadowbrook Hospital, Hempstead, 1938-. Diplomate American Board of Urology, 1940. Nassau Surgical Society; Bergen County Medical Society, N. J.; Nassau County Medical Society; New York State Medical Society; Association of Physicians of Long Island; American Urological Association.

Strange, William W., Commander (MC) U. S. N. R. (*The Late Treatment of Flash Burns*, p. 953). M. D., University of Virginia, 1918. Senior surgical staff, St. Marys Hospital, Huntington, W. Va.; attending staff, Memorial Hospital, Huntington. Fellow American College of Surgeons.

Sweet, A. Porter S., Lieutenant Commander (DC) U. S. N. R. (*X-ray Film Storage*, p. 1159). D. D., University of Buffalo, 1918. General practice, Hornell, N. Y., 1918; staff dentist, St. James Mercy Hospital, Hornell, N. Y., 1936; consulting dentist, Bethesda Hospital, Hornell, 1937; editor, *Dental Radiography and Photography*, 1938; associate editor (radiodontics), *Journal of the Dental Society of the State of New York*, 1939; consulting dental radiologist, research dept., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y., 1942. Member American Dental Association; Dental Society of the State of New York; Seventh District Dental Society; Rochester Dental Society; Pierre Fauchard Academy; American Association for the Advancement of Science (Dental Subsection); International Association for Dental Research; Rochester Academy of Science.

Taranto, Michael, Lieutenant (MC) U. S. N. R. (*100 Consecutive Cases of Cerebrospinal Fever at Camp Endicott*, p. 961). A. B. Lehanon Valley College, 1920; M. D., Georgetown University School of Medicine, 1934. Intern, Elizabeth General Hospital, New Jersey; assistant neuropsychiatrist, 1935-38; assistant, orthopedic surgery, 1938-42; general practice 1935-42. Member Union County and State of New Jersey Medical Societies.

Thorne, Irving J., Lieutenant (MC) U. S. N. R. (*Predisposition to Compressed Air Illness*, p. 1044). B. S., University of Virginia, 1930; M. D., Harvard Medical School, 1934. Contract physician and surgeon, U. S. C. C. C., July 1935-Jan. 1936; rotating surgical internship, Harlem Hospital, New York City, 1936-38; clinical assistant visiting surgeon, Harlem Hospital, 1938-39; clinical assistant visiting surgeon, Bellevue Hospital, 1938-39; medical staff, Walsh Construction Co., N. Y.; member Medical Advisory Board of the Associated Hospital Service of New York, 1939-40; assistant attending surgeon, Downtown Hospital and Pan American Clinic, Broad Street Hospital, service of Dr. Edward L. Kellog, 1939-. Diplomate National Board of Medical Examiners, 1935; member New York County and State Medical Societies; fellow American Medical Association; Harvard Medical Society of New York; Association of Military Surgeons of the United States; junior fellow American College of Surgeons; Pan American Medical Society.

Ulmar, David, Lieutenant Commander (MC) U.S.N.R. (*A Simple Face Mask*, p. 1161). M. D., College of Physicians and Surgeons, Columbia University, 1925. Visiting physician, secretary of Medical Board, Sea View Hospital, Staten Island; visiting physician, chief of pulmonary clinic, Metropolitan Hospital; assistant physician, chief of chest service, New York Post-Graduate Hospital; consultant, chest diseases, New York City Welfare Hospital; member Medical Board, Stony Wold Sanatorium, Lake Kushaqua, N. Y.; supervisor of clinics, New York City Dept. of Health; assistant clinical professor of medicine, New York Post-Graduate Medical School, Columbia University; assistant professor of medicine, New York Medical College. Fellow American Medical Association; American College of Physicians; member American Trudeau Society; New York Society for Thoracic Surgery, Tuberculosis Committee of New York Tuberculosis and Health Association.

Van Orden, Thomas D., Lieutenant Commander (MC) U.S.N.R. (*Treatment of Cerebrospinal Fever, Meningococcic*, p. 973). B. S., Dartmouth College; M. D., College of Physicians and Surgeons, Columbia University, 1922. Intern, medicine, Roosevelt Hospital, New York City, 1922-24; intern, pediatrics, Nursery and Childs Hospital, New York City, 1925; assistant pediatrician, New York Hospital, Cornell Medical Center, 1934-; instructor clinical pediatrics, Cornell Medical School, 1934-. Certified by American Board of Pediatrics. Member American Medical Association; New York County Medical Society; New York Academy of Medicine; American Academy of Pediatrics.

Webster, George V., Lieutenant (MC) U. S. N. R. (*A Dermatome for Cutting Small Skin Grafts*, p. 1145). Stanford University, 1928-1932; M. D., Stanford University School of Medicine, 1937. Intern, surgery, Stanford-Lane University Hospital, 1936-37; assistant resident, surgery, 1937-38; assistant in pathology, Stanford University, and assistant visiting pathologist, San Francisco Hospital, July 1938-January 1939; surgical house officer, Stanford-Lane University Hospital, January 1939-July 1939; junior resident in surgery, Presbyterian Hospital, New York City, and assistant in surgery, Columbia University College of Physicians and Surgeons, July 1939-July 1940; resident in surgery (plastic and reconstruction) Presbyterian Hospital, New York City, July 1940-January 1942.

Zieman, Stephen A., Lieutenant Commander (MC) U. S. N. R. (*Perforating Foreign Body of Cecum*, p. 1103). A. B., Gonzaga University, 1923; A. M., 1934; M. D., Rush Medical College, 1932. Head, dept. biology and pre-medical science, Spring Hill College, 1924-27; head, dept. of science, Thornton Township Junior College, Harvey, Ill., 1927-28; professor, chemistry, and head, dept.

of physics and chemistry, De Paul University, Chicago, 1928-36; clinical instructor, gynecology, 1934-; clinical assistant in surgery, Rush Medical College, 1933-; lecturer surgical anatomy and postgraduate school; private practice, surgery, Chicago, 1933-. Fellow American Medical Association; American College of Surgeons; Illinois State and Chicago Medical Societies; former fellow American Association for the Advancement of Science; American Chemical Society; Chicago Chemical Society; American Physics Society; Chicago Physics Society.



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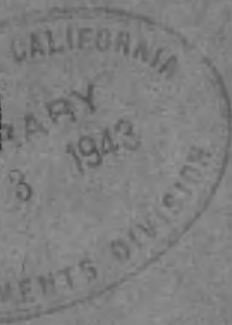
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THE MISSION OF THE MEDICAL CORPS OF THE NAVY



**TO KEEP AS MANY MEN AT AS MANY GUNS
AS MANY DAYS AS POSSIBLE**

Issued Bimonthly by the Bureau of Medicine and Surgery
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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

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ROSS T McINTIRE,
Surgeon General, United States Navy.

III

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The editor regrets to have to say that reprints of articles can no longer be supplied by the Government Printing Office.

ROBERT C. RANSELL, *Editor,*
Commander, Medical Corps,
United States Naval Reserve.
STEPHEN A. ZIEMAN, *Assistant Editor,*
Lieutenant Commander, Medical Corps,
United States Naval Reserve.

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SPECIAL ARTICLES

THE MEDICAL DEPARTMENT OF A BATTLESHIP IN ACTION

JOSEPH A. SYSLO

Lieutenant Commander (MC) U. S. N.

Much has been said and written about the conduct of medical departments afloat in preparation for, during, and after battle. The information usually encountered is of two varieties; either general and of broad scope, not applicable to any one war vessel but usually sound fundamentally, and practicable if it can be altered in detail to be suitable for a given vessel; or, concise and pointed details of methods, procedures and medications, the results of which can be used as guides to the solution of various specific problems.

The purpose of this paper is to describe the medical organization of a modern battleship, the U. S. S. ———, the difficulties and problems encountered before, during and after battles, and the types of battle casualties and their management.

For the sake of clarity, it may be well to point out that with the exception of one battle dressing station and a few first-aid stations, the medical department to be described is so located that it has armor above, in front, behind and on its left and right sides; that it is on the third deck; that during general quarters or when battle is imminent, all doors and hatches are closed and all medical personnel below the main deck is confined to relatively small areas and cannot move freely about the ship; and that during battle, approximately one-half of the medical department personnel is below armor.

In general, the important features in the organization of this medical department are the wide dispersion of medical supplies and personnel, and the instruction of the entire complement of the ship in the elements of battle first-aid treatment. Personnel and matériel are so distributed throughout the ship that first aid can be administered anywhere from its bottoms, as in the shaft alleys, to the uppermost or twelfth level of the superstructure. Moreover, if during battle, one or even two parts of the ship are so severely damaged that medical sup-

plies and personnel are destroyed in those parts but the ship remains afloat, the distribution is of such a nature that the third and remaining part of the ship has sufficient medical facilities to carry out even major surgical procedures.

On the third deck, below armor, there are 2 battle dressing stations: One forward, consisting of the entire peacetime sick bay area, composed of 2 medical store rooms, a 36-bed sick bay, surgical dressing room, operating room, scrub room, dispensary, laboratory, record office, doctors' office, a 2-unit dental office, isolation ward and air-conditioning unit; the other is located aft of the machinery spaces in a living compartment having approximately 180 beds and 1 medical storeroom. This latter space contains 2 large lockers devoted entirely to emergency surgical and medical appliances and supplies, and is provided with a portable operating table, electric sterilizer, and all essential items for performing emergency major surgery. A third battle dressing station, similar in many respects to the second of the 2 just described, is located on the main deck, amidships, just aft of the wardroom which is used as a collecting station, and in the immediate vicinity of a berthing space containing approximately 200 beds. This dressing station, too, is so equipped that major surgical procedures can be carried out with relative ease.

In addition to the above dressing stations, there are two first-aid stations, one on the seventh level above the main deck forward, and one on the third level above the main deck aft. These first-aid stations are supplied with moderate quantities of all first-aid materials except those necessary for performing major surgery. On the second deck, there are two small first-aid stations, one far forward and one far aft; here, a small amount of first-aid material is kept to provide emergency treatment for a relatively small group of men whose battle stations are on the second deck. On the main deck, forward and aft, in the immediate vicinity of good shower facilities, there are two gas-decontamination stations which, in the absence of a chemical attack, function as first-aid stations.

Medical supplies are further dispersed in comparatively small quantities in 2 additional store rooms. First-aid boxes, numbering approximately 140, contain battle dressings, bandages, cotton, tourniquets, powdered sulfanilamide and morphine Syrettes, and are dispersed throughout the ship, particularly in or near areas occupied during battle. Five portable battle lockers, measuring 20 by 20 by 30 inches, contain dressings, bandages, cotton, splints, emergency surgical instruments, blood plasma, morphine, sulfonamides, etc., and are used to convey treatment to casualties who for one reason or another cannot be brought to a collecting station. Gun bags, consisting largely of cotton, bandages, and adhesive tape are provided for all machine-gun mounts.

Morphine Syrettes (morphine tartrate gr. $\frac{1}{2}$ in collapsible tube with attached sterile needle) are widely distributed. Every commissioned, warrant, and chief petty officer is given a box of five Syrettes, for which he signs and assumes responsibility. They are also placed in varying quantities in all first-aid boxes, portable battle lockers, hospital corps pouches, first-aid and battle dressing stations. Every box of Syrettes is numbered, and around the narrow edge of each box are placed six strips of adhesive tape 10 inches long and $\frac{1}{2}$ inch wide; one of these is strapped around the wrist or ankle of a casualty to indicate that he has received a full dose of morphine.

The last important item of essential battle medical supplies that requires attention in distribution is the stretcher. Three types are found on this ship: The Stokes or wire-basket stretcher, numbering 57, whose good qualities need no comment; the metal-pole or Army type litter, 63 in all, which is not adaptable to transporting patients up or down steep inclines (its use, however, in transporting chemical warfare casualties should be kept in mind); and lastly, the canvas stretcher, 40 in number, which is light, compact, flexible or rigid as desired, and particularly useful in removing casualties from badly cramped spaces, through small hatches and doors and up or down ladders. The best known canvas stretcher, in all probability, is the Weber-zipper stretcher. However, because of undesirable features, fanciful or real, inherent in the Weber-zipper stretcher, a canvas stretcher of our own design was used; its essential differences consist of simplified straps of canvas webbing, and lashing of the canvas jacket instead of closure by zipper.

Instructions in first aid given to the entire ship's complement, consist of both indoctrination in principles relative to first-aid treatment in battle on board a war vessel, and the barest essentials of first aid itself. The entire problem of first aid is limited to the emergencies of battle. Self-help among the crew is stressed. All injuries, whether burns, damage to soft tissues, fractures, blast, or any combination of these, are divided into major and minor injuries, not so much from a medical standpoint but rather with respect to what influence the injury to the man has on the fighting efficiency of the ship. Treatment is outlined accordingly. Shock, burns and hemorrhage are given special consideration. The use of tourniquets is discouraged, and the application of strong or highly colored antiseptics to wounds is mentioned only to be condemned. The use of battle dressings, roller bandages, sulfanilamide powder, and morphine Syrettes is fully demonstrated, and the control of hemorrhage by various methods described. These instructions are supplemented by repeated showings of an admirably composed movie film on first-aid treatment.

Hospital corpsmen are given much more detailed instructions in the management of battle casualties. Thus, besides the subjects of first aid and transportation of the wounded they are taught the following; minor surgery, the use of splints, administration of chloroform and ether, intravenous medication, and the method of preparing and administering blood plasma.

The problem of transportation of battle casualties to collecting stations and to the sick bay was given much thought. Heretofore, it has been customary for a medical department battle organization to have specifically designated members of the crew in addition to hospital corpsmen for the purpose of carrying wounded men. It was believed that such a provision was too rigid, and that a group of men so appointed would be either completely useless to the ship during battle, or if employed during battle for purposes other than medical aid, would not be available for stretcher bearing when most needed. Therefore, it was decided to employ all available men not actually manning battle stations to carry the wounded, that operation to be supervised by medical and dental officers and pharmacist's mates. This plan worked exceedingly well on two occasions; a sufficient number of the crew volunteered its services to form the equivalent of "bucket brigades," and transportation of the wounded was rapid, without discomfort to the patients, and not exhausting for the stretcher bearers. An additional desirable result was achieved; medical department personnel was not too tired to execute properly its long hours of exacting duties that followed in the sick bay area and operating room after the casualties were collected and evaluated.

During general quarters or when the ship is about to engage the enemy, members of the medical department go to their various battle stations. Two medical officers, one dental officer and eight hospital corpsmen are assigned to the forward battle dressing station on the third deck. One medical officer, one dental officer, one warrant pharmacist and six hospital corpsmen occupy the battle dressing station on the third deck aft. The senior medical officer, chief pharmacist's mate and six hospital corpsmen man the battle dressing station on the main deck. Each of the two decontamination stations on the main deck is in the care of two hospital corpsmen. Two hospital corpsmen are likewise assigned to each of the first-aid stations in the superstructure, and one hospital corpsman mans each of the first-aid stations on the second deck.

PREPARATION FOR BATTLE

Preparation for battle, in a broad sense, involves many procedures, the intricate details of which consume months of tedious work before they are satisfactorily completed.

The work of the medical department during war has but one purpose—to increase the fighting capacity of the ship. To that end, the welfare of the individual, at times, is deliberately sacrificed for the good of the ship. The quantity of medical and surgical supplies is carefully computed, bearing in mind that they have to be widely dispersed. The physically unfit and mentally unstable individuals are carefully observed, and those whose physical defects cannot be corrected or who are unable to make satisfactory mental adjustments are gradually removed from the ship. Cases of malingering and outright fear do not, as a rule, occasion real difficulties. Immunizations, blood typing of the entire ship's complement, and the making of identification tags for all on board consume a great deal of time; the difficulties can easily be imagined if it is remembered that every department on the ship considers its own duties at least as important as those of any other department, and, therefore, its time and that of its men as valuable—all of which is correct. However, the cooperation and integration of the work of all departments is absolutely necessary. In that respect, first-aid instructions to the crew, a tedious, thankless job which took months to complete because of lack of full cooperation by all departments on the ship, assumed their full meaning and importance only during and after the first battle; thereafter, it was usually difficult to find a space large enough to accommodate those interested in the instructions.

In the restricted sense, preparation for battle is taken to mean the evolutions that the medical department undergoes when a battle is imminent.

With the signal for general quarters, all medical and dental officers and hospital corpsmen proceed to their assigned battle stations. With them they have the usual devices for self-protection, such as flashlights, steel helmets, life preservers, gas masks, etc. At the battle stations all emergency supplies and facilities are brought out, assembled and made ready for instant use; this always includes a portable operating table, electric sterilizer, running water from gravity tanks, sterile supplies, stretchers, portable battle lockers and splints. This operation takes from 7 to 10 minutes. From the time of completion of preparations until the ship is secured from general quarters, the hospital corpsmen occupy themselves in various ways; as a rule, this time is spent in first-aid training. With the occurrence of an actual engagement, however, it is impossible to divert minds, including one's own, from battle; a tenseness can be sensed, although neither overt fear nor hysterical behavior was witnessed.

As previously mentioned, all medical department personnel below the main deck is confined to relatively small areas. During battle, they cannot come up to the main deck or above, except when damage

control or repair parties in their areas are ordered to investigate or to repair structural damage. Under those circumstances, orders for a medical officer or hospital corpsmen to proceed to the site of casualties issue from the senior medical officer, the officer in charge of the battle dressing station, or in their absence, from the damage-control officer.

Those on or above the main deck, however, have access to all the higher levels of the ship. Long before the ship is secured from general quarters, they begin the administration of first aid and the collection of casualties; the latter are given emergency treatment wherever they are found; if it is convenient or necessary, they are moved to a collecting station; otherwise, transportation of patients is delayed until a lull in battle or after completion of the engagement.

CASUALTIES AND THEIR MANAGEMENT

The first battle in which this ship participated, that off Santa Cruz Island in the Southwest Pacific, occurred on October 26, 1942. General quarters continued from 0900 until about 1500. Our forces were engaged by enemy dive bombers and torpedo bombers. One direct hit with a 500-pound bomb was scored on this ship.

At the time of this battle, the main deck battle dressing station was already established and functioning. No provisions for such a station were made in the original plans of the ship. This station proved to be most important to the control of medical department activities during and immediately after battle. Contact by telephone was maintained with all other battle dressing and first-aid stations, and additional help was obtained from them whenever needed.

Thus, immediately after the bomb struck the top of a turret, it was noted that most casualties occurred on the main deck and first superstructure, predominantly on the starboard side; bomb fragments were scattered widely and seriously wounded an officer on the bridge or fourth level above the main deck.

All firing ceased after this hit, as no more enemy planes were visible. Collection of casualties into the wardroom was done largely by members of the crew under the supervision of corpsmen and medical officers. Administration of first aid went on rapidly, and with it an evaluation of the extent and gravity of damage done to each individual. The patients were then classified on the basis of further urgent treatment required; those, therefore, who needed hemostasis, antishock treatment, blood transfusions or abdominal exploration were the first to be moved from the collecting station to the sick-bay area which had been prepared for their reception.

The following routine was established for admission of casualties to the sick bay; all ambulatory patients, previously in the sick bay,

were evacuated prior to the battle. All empty beds were freshly made. The injured, brought down on stretchers by members of the crew, were stripped of all their clothing in a passage leading to the sick bay, and were then put to bed. This procedure facilitated further examination, circumvented moving the patient excessively once he was in bed, and prevented loss of time in preparation for further treatment and operative procedures; it also saved much bed linen, shortage of which can create an exasperating problem. Since the sick bay has a total of 36 beds, the overflow of casualties was accommodated in a Marine berthing space on the second deck forward.

When all the casualties were collected in the sick bay and Marine berthing space, definitive treatment was begun. All received a booster of tetanus toxoid. Sulfathiazole by mouth was administered to everyone, and thereafter was repeated every 4 hours. This method of medication eliminated the possibility of confusion and error so often attendant upon mass treatment under exciting conditions.

The treatment of shock continued. It might be pointed out that in this engagement shock was not a serious problem, probably for two reasons: First, the absence of burns; second, the absence of initial physical exhaustion, since both officers and men had sufficient rest on the night preceding the battle. A medical officer examined each case, and by the usual criteria for giving antishock treatment, indicated those requiring intravenous therapy to a group of pharmacist's mates especially designated for the purpose. The administration of blood plasma and saline and dextrose solutions was carried out by the hospital corpsmen. The collection, preparation and administration of citrated whole-blood remained in the care of a medical officer.

The most urgent emergency problem was considered to be hemorrhage. It is extremely interesting to note that in only two instances were measures more radical than a snugly applied battle dressing necessary to control bleeding. In one, an officer who sustained a perforating wound of the neck in which the jugular vein and superior thyroid artery were severed, digital pressure was used initially; bleeding to the exterior was soon controlled, but hemorrhage into the tissues of the neck continued and was so severe that exploration of the neck wound was necessary to save his life. The patient had a complete paralysis of his entire left upper extremity including loss of deep and cutaneous sensations, from involvement of the brachial plexus. On exploring the wound, so much shredding of tissues and so much infiltration of blood were encountered that more than the ligation of bleeding vessels was considered unjustified. The other casualty required the application of a tourniquet to his leg because of bleeding from a severed posterior tibial artery. The tourniquet was removed in about 15 minutes and the bleeding artery

ligated. Oozing of blood from wounds was moderate but not sufficiently serious to require more than the application of a pressure bandage. Some wounds, although extensive and serious, were seared or heat-coagulated throughout their lengths by the heat of the bomb fragments; these did not bleed at all. In that connection, it had been stressed in first-aid instructions, not to remove embedded foreign material, particularly fragments of bomb or shell, since it was felt that uncontrollable hemorrhage might result from the manipulations required to remove the metal fragments. This was later found to be true in occasional cases that were brought to the operating room for treatment. The fragments obviously exerted enough pressure on severed vessels to stem hemorrhage, and upon their removal bleeding of a serious nature resulted.

Intra-abdominal injuries were considered second only to severe bleeding. Wounds caused by missiles which obviously had penetrated the abdominal wall, and all those highly suspected of involving intra-abdominal viscera, were minutely investigated, in occasional instances enlarged and probed. As a result, two exploratory laparotomies were performed, both within 6 hours of the termination of the engagement. In one, with a wound of entrance in the ninth intercostal space in the left mid-axillary line, the following damage was found: Perforation of the left leaf of the diaphragm, laceration of the spleen, and a 2-inch laceration of the anterior wall of the stomach with gastric contents throughout the peritoneal cavity. The other sustained a puncture wound of the abdomen which, on exploration, revealed a laceration of the large bowel with fecal contamination of the peritoneum. Such repairs as were deemed necessary were made in both instances. The peritoneal cavities were cleaned of as much of the contaminating agents as possible, and 5 grams of powdered sulfanilamide was left in each. The chest wound was debrided and dressed but not sutured; in this case, the abdomen was not drained. One drain was inserted into that abdomen in which the large bowel was injured. Both of these cases were convalescing satisfactorily when transferred 3 or 4 days later to a hospital ship.

One combined pelvic and abdominal injury consisted of a huge perforation with its wound of entrance anteriorly in the pubic region and its wound of exit in the left buttock; it involved the pelvic girdle, urinary bladder, small and large bowel, and resulted in profound shock that did not respond to treatment. No surgical procedure was attempted and the patient died 4 hours after sustaining his injury.

The casualty next to demand surgical interference was considered to be the compound fracture. Of the 50 individuals injured in this attack, 10 had one or more compound fractures. Of these, 7 were of

the bones of the lower extremities, 2 were of the upper extremity, and 1 was of the lower jaw. Fragmentation or comminution of bones was extensive. All of these wounds were debrided, and except that of the lower jaw, were opened widely; foreign bodies and loose bone fragments were removed. Sulfanilamide powder was then dusted into the wounds, and the latter lightly packed or covered with sterile vaseline gauze. Thomas splints with skin traction were used for fractures of the femur; in the 1 exception, which consisted of a large perforating wound of the left thigh, compound fracture of the neck of the femur, and extensive damage to the perineum and external genitalia, a pillow splint was used. Plaster of paris casts and splints were applied to fractures of legs and forearms. Skeletal fixation and traction were not employed.

The remaining wounds were those of soft tissues. As was previously mentioned, there were no cases of burns. All of the wounds under discussion were either excised or debrided. A special effort was made to remove all metallic fragments. Perforating wounds of the extremities not involving bone were not widely opened when the only benefit to be derived from such a procedure would be the exposure of the entire wound tract. Lavage was not performed even in cases of intra-abdominal injuries. Extensive excision of tissues was not found necessary. Gentle sponging with saline-soaked gauze was the usual method employed to cleanse wound surfaces. Small wounds, as a rule, were enlarged. All wounds were dusted with sulfanilamide powder, and either lightly packed or covered with sterile vaseline gauze. Suturing of wounds, except those opening into body cavities was not permitted. Redressing was done relatively frequently—every 2 to 4 days at first—and the “knife and fork” technic was employed in all instances. No infections were seen.

Of several patients who had large wounds of extremities, one was subjected to an amputation through the middle third of his leg because of early gangrene due to complete severance of the blood supply in the distal third of that leg. Skin flaps were fashioned, and sutured after the amputation. Recovery was uneventful.

Marked swelling of injured extremities was noted in several instances. This was particularly true in penetrating and perforating wounds in which the injury to the skin was relatively small. X-ray examination of such extremities frequently disclosed numerous small bubbles of gas along the fascial planes and within the muscles. Free enlargement of the skin wounds and opening of some of the fascial planes disclosed healthy tissue, the gas bubbles evidently being air, sucked or driven into the tissues. After such enlargement, the swelling subsided rapidly and the wounds healed without complications. No instance of gas bacillus infection was seen.

Secondary suture of wounds was discouraged but undoubtedly could have been carried out with relative ease. Instead, however, as soon as a wound showed early healthy granulations, it was pulled together with adhesive tape after the surrounding skin had been painted with compound tincture of benzoin, and complete healing was often accompanied by surprisingly little scarring.

Immediate preparations were being made for further engagements with the enemy. Transfer of all disabled casualties was imperative. Eleven of the fifty casualties were thus sent to a hospital ship, the remainder being retained on board. Replenishment of medical supplies was obtained from a near-by shore establishment and a supply ship.

On November 15, 1942, 3 weeks after the above engagement, this ship participated in a surface battle with Japanese warships at Guadalcanal in the Solomon Islands. The action took place just after midnight and lasted 35 minutes. This ship was exposed to enemy fire on its starboard side, and numerous enemy shells found their mark.

The dispersion of medical department personnel and supplies was identical with that of the previous battle.

Unforeseen difficulties were encountered even before the treatment of casualties was begun. Perforations in the superstructure of this ship caused by enemy shells would not permit the use of white light on the main deck and above. As a result, the differentiation between some of those seriously wounded and those dead became almost impossible. It became obvious that provisions should have been made before battle to use "black-out" flashlights in areas where ordinary white light would certainly give away our position to the enemy. A fire main was ruptured on the fifth level of the superstructure and the cascade of water flooded some areas from that level below to a height of 8 inches; it was imperative, therefore, to remove or at least change the position of those wounded and helpless who were lying prone or supine on the decks in order to keep them from drowning. There were many casualties as far up as the twelfth level of the superstructure; and as several ladders were shot away, the only access to the injured was by climbing upward on the rungs welded to the outside of the tower. It was in this battle that the importance and usefulness of the canvas stretcher was realized.

Emergency treatment and collection of the injured was begun immediately. With the difficulties enumerated above, it can readily be seen that collection of the injured and even recognition of them was no easy matter. Each level was methodically searched. The injured were given such treatment "on the spot" as was indicated and were then transported to the collecting station. Removal of the dead was not undertaken until daybreak.

Transportation of the wounded was carried out in the same manner as after the previous battle, with the same gratifying results. A routine identical with the one described above was followed before casualties were admitted to the sick bay; sulfonamides by mouth and a booster of tetanus toxoid were given to all the injured after they were collected in the sick-bay areas.

There was a total of 120 casualties on board in this engagement. Of this number, 5 officers and 30 enlisted men were killed during the action. One officer and 4 enlisted men were critically injured when first seen, and all died within 12 hours despite intensive treatment. Of the remaining number, 22 were classified as having a serious prognosis, 30 as having a favorable prognosis, and 28 as having minor injuries and not to be retained in the sick bay. This classification was based on the appearance of the patient, the number, extent and location of injuries, the degree of shock, apparent loss of blood, the pulse, blood pressure, severity and area of burn, and the initial response to emergency treatment.

A notable feature of these injuries was the severity of the accompanying shock as compared with the injuries of the previous battle. It was obvious that the number of serious injuries was greater; moreover, a certain percentage of the casualties were burns. Nevertheless, the intensity of the shock seemed out of proportion to the severity of the injuries. In comparing the circumstances surrounding the two engagements, the only pertinent difference was the time of the battles—the one occurring about midday after the officers and men had had relatively sufficient rest during the preceding night, and the other taking place just after midnight, when practically all hands had been up and about for 16 to 20 hours. It was reasoned, therefore, that physical fatigue probably played a definite role in increasing the intensity of the shock.

Excluding those who were killed during the engagement, the types of injuries encountered were as follows: Serious hemorrhage not controlled by ordinary pressure bandage—1; intra-abdominal injuries requiring exploratory operation—2; burns—16; individuals with one or more compound fractures—24; soft tissue injuries not included in the above formed the remaining and largest group. Mutilation was fairly extensive because the fragments causing the injuries were sharp, jagged, and irregular.

In importance, burns were given precedence over fractures and soft tissue injuries. The topical use of tannic acid as an emergency or definitive measure was discouraged. All serious cases of burns were given the usual antishock treatment including human blood plasma intravenously. Local treatment was begun as soon as possible; this consisted of applying 5-percent sulfathiazole ointment spread on

thick gauze and bandaging the whole firmly and evenly. Dressings were changed relatively frequently. Debridement was not done at the initial local treatment but at redressings, and then gently, without anesthesia or additional sedatives. Intra-oral and pharyngeal burns gave many anxious moments; in one such case in which suffocation was threatened due to the marked edema, tracheotomy was probably averted by spraying the pharynx with a mixture of 2 percent cocaine solution and 1:1,000 adrenalin.

The remaining types of injuries were treated as discussed previously. It is emphasized again that all efforts were made to remove bomb and shell fragments, not in fear that a wound containing such material would not heal, but because in time, pain would be experienced in the extremity or area, and would necessitate another operation to remove the fragment. This has been found to be true already in at least five instances in which a wound was allowed to heal without such removal.

The question of anesthesia is interesting. Intravenous pentothal sodium, novocaine intraspinally, procaine hydrochloride local infiltration and nerve block, ether, and chloroform inhalation were all used in frequency in the order listed. The intravenous anesthetic was most useful, and mild shock was not regarded as a contraindication. In fact, given carefully, less pentothal was required to maintain anesthesia in cases of mild shock than in those who were not in shock; moreover, reflex, spasmodic cough during the anesthesia was noted more frequently in those completely free from shock than in those partially in shock; no untoward aftereffects were noted following the completion of administration of the intravenous anesthetic.

Identification, collection, and arrangements for the burial of the dead were done by the chaplain, senior dental officer, and the chief pharmacist's mate. This tedious and unpleasant duty occupied approximately 12 hours. No serious difficulties were encountered. Burial at sea was completed at the end of the day of battle. It is pointed out here that when a body is buried at sea, the weighted shroud should have holes cut in both its ends so that the imprisoned air within might escape and allow the body to sink.

With the exception of approximately 10 individuals, the remaining casualties of the second battle were retained on board. Wounds were dressed regularly whenever the dressings became soiled. The closed plaster treatment was not followed in most instances; this obviated odors, the concealment of infections, pressure sores, and the technical difficulties attendant upon application of large plaster casts at sea.

Only one infection was noted in a very severe compound fracture of the upper one-third of the left leg involving the knee joint; the closed plaster technic including sulfanilamide powder locally after

thorough excision of the wound was the initial definitive treatment. Removal of the cast, multiple incisions into the knee joint and suprapatellar bursa were necessary; subsequent drainage and irrigations finally resulted in subsidence of the infection.

Despite severely mutilating wounds, amputation of extremities was purposely avoided. Several instances were seen in which large areas of a limb were denuded of skin, the underlying tissues apparently badly damaged and soiled, the supporting bone frequently severely shattered, and the extremity or a segment of it markedly swollen. And as noted before, on x-ray examination bubbles of gas were frequently seen beneath skin, in muscles and beneath fascia. It was remarkable to see how rapidly these extremities healed in nearly every instance. With patience and cooperation from these convalescing casualties, function could, in most instances, be restored to the injured parts.

SUMMARY

The important features of the organization of the medical department on board this ship are wide dispersion of medical supplies and personnel and instruction of the entire complement of the ship in the elements of battle first-aid treatment. Collection and transportation of casualties are simplified by engaging as stretcher bearers all hands not actually manning their battle stations.

Injuries incurred during the night surface engagement were attended by more severe shock than those sustained in the attack at midday by enemy planes. Uncontrollable hemorrhage was not a serious problem and the tourniquet was used very infrequently. Intra-abdominal injuries were second in importance only to severe hemorrhage; all were treated within 6 hours after the injuries were incurred. Compound fractures constituted approximately 20 percent of all injuries. Most of the compound fractures were treated by free incision of the external wounds, removal of foreign bodies and loose fragments of bone, excision of a minimum of tissues, dusting with sulfanilamide powder, loose packing with sterile vaseline gauze and immobilization by Thomas, Jones, or plaster of paris splints. Amputation of a severely injured extremity was necessary in only one instance. With the exception of abdominal wounds and those exposing joints, wounds were not sutured, and numerous wounds were enlarged by free incision. Every effort was made to remove shell and bomb fragments embedded in tissues. Secondary closure of wounds was accomplished with adhesive tape rather than with sutures.

Unforeseen difficulties were encountered after the night engagement, namely, the inability to use ordinary light in areas where

personnel casualties occurred, and difficulty in reaching casualties because of the destruction of ladders.

Many anesthetic agents were used, pentothal sodium intravenously most frequently. Mild shock was not considered a contraindication to intravenous anesthesia. In the postoperative care of the wounded, dressings were changed frequently and were handled aseptically. Of the wounded retained on board, only one developed a severe infection entailing reoperation.

No serious difficulties were encountered in identifying the dead; all were buried at sea.



INSULIN REACTIONS

The circumstances which lead to insulin shock are:

1. Error in dosage, arising from oversight in insulin administration, as when a more concentrated insulin has been ordered by the physician or is inadvertently taken by the patient.

2. Overdosage during the initial period of insulin and dietary regulation.

3. Unusual physical activity with its increased and improved carbohydrate utilization by muscle as after golf, or mountain climbing, or trudging thru snow.

4. Delay in eating due to any one of a number of unforeseen causes, e. g., the late arrival of a train, nausea, gastric upset, fever, or accident.

5. Unexplained spontaneous decrease in the insulin requirements of an individual, or a suddenly improved carbohydrate tolerance as a result of subsidence of temperature, infection, or other state of hypermetabolism.

6. Failure to assimilate ingested food because of delayed gastric emptying as in pylorospasm, food sensitivity, or idiosyncrasy.

7. During postoperative periods or in convalescence from febrile diseases when the patient is depleted and when food is frequently refused, the usual dose of insulin may be profound in its effect.

8. The sudden hydration of a patient who had been dehydrated, as in diabetic coma, is not infrequently associated with a landslide effect from insulin which by repeated injections has accumulated in the tissues.

9. Accidental intravenous injection of insulin in an "insulin sensitive" individual may result in profound and rapid insulin effect. (This can be avoided by warning the patient always to "pull back" on the plunger of the syringe and look for the presence of blood before injecting the insulin into the tissues.)

10. Routine "covering" of intravenous glucose by insulin may lead to insulin reaction, since not infrequently glucose per se will act to stimulate the patient's own intrinsic insulinogenic mechanism—with a resulting summation of insulin effect—The New York Diabetes Association, Inc.: Insulin reactions in the aged. No. 23. Fundamental Concepts in the Treatment of Diabetes Mellitus and its Complications.

WAR WOUNDS OF THE HEAD

JOHN T. B. CARMODY

Lieutenant Commander (MC) U. S. N. R.

Cranial wounds sustained by gunfire vary in severity as do cranial injuries encountered in civilian life. The wounds may be single or multiple consisting of simple scalp penetrations by shell or grenade fragments, or may result in extensive shattering of the skull with laceration of the brain and subsequent infection. These latter cases simulate the major compound fractures of the skull vault so often seen in automobile accidents excepting that frequently they are further complicated by the retention of foreign bodies. It is this group that requires major surgical intervention and with which this paper deals.

The cases in this series were casualties of the Guadalcanal campaign. Actually no definite statistics concerning the incidence or mortality rate of gunshot wounds of the head are available, but the impression based upon the opinion of medical officers who took active part is of interest. In the first place the head wounds formed a small percentage of the total, and secondly, the fatalities resulted primarily from a direct hit by high-velocity fire. All agreed that the American helmet, although it could not prevent high-velocity penetration, was efficient, especially so in deflecting hits from fragmentations. The method of handling these cases was in general the same in all instances. If wounded on the front lines, the patient was given first-aid treatment consisting of sulfanilamide powder applied locally, followed by a compression head dressing. He was then moved as soon as feasible through the various substations, where support by intravenous plasma was always administered, to the division hospital. Here the cases were sorted and the more serious were put in the best possible condition for plane transportation to the nearest base. Further intravenous injections of plasma were given; chemotherapy was started, and when necessary, debridement of the wound was also carried out. Those patients who could not return to duty within a reasonable period and those who would not be fit for further duty were next transported to one of the major bases for further disposition. Therefore an interval of from 2 to 3 weeks usually elapsed before casualties of this classification arrived at a major base.

The cases in this series are chosen from those admitted to a major base. They are interesting especially in that the seriousness of their condition on admission and the severity of the cranial involvement was

not due to the initial injury alone, but rather it was due to the development of complications. Of these, the most common noted were osteomyelitis, retained fragments of bone and foreign bodies, brain abscess, and meningitis. There were 12 cases that fitted into this classification. All required operative intervention and in some, several procedures were necessary. There were no deaths. The operative technic varied from the accepted method of treating an acute case by total debridement with complete closure to those necessitating drainage. The series has been divided into two groups—those admitted with closed wounds free of infection and those characterized by draining infected wounds.



1. (CASE 1). A RIGHT LATERAL SKULL FILM WHICH SHOWS IN-DRIVEN BONE SPLINTERS AND A RETAINED SHELL FRAGMENT.

There were 2 cases in the former category—their diagnoses were compound, comminuted, depressed fractures of the skull with laceration of the brain. On admission the general condition was satisfactory and operative repair was accomplished without incident. The second group presented a different problem. Of the 10 cases, 7 were placed on the serious list immediately following admission. All had the common finding of osteomyelitis of the skull, further complicated in that 8 had in-driven skull fragments and 3 of these had retained foreign bodies. One other case presented a cerebral fungus associated with 2 brain abscesses. Finally there was 1 generalized meningitis secondary to the bone involvement.

Three of these cases have been chosen specifically in order to illustrate some of the complications. They have been summarized briefly.

CASE REPORTS

Case 1.—A Marine corporal, 21 years of age, was wounded by a shell fragment on Guadalcanal on October 26, 1942. The fragment penetrated his helmet knocking him unconscious for an undetermined length of time. Routine supportive and prophylactic measures were given. Approximately 3 weeks later he was admitted to this base for final treatment and disposition. At the time his general condition was fair. He was conscious, but mentally dulled and dis-



2. (CASE 1). A POSTERIOR-ANTERIOR SKULL FILM WHICH SHOWS THE ENTRANCE WOUND, IN-DRIVEN BONE SPLINTERS, AND A SHELL FRAGMENT.

oriented. He complained of headache with disturbance in vision. Examination of the head revealed the entrance wound to be in the right occipital area. The wound was draining and a herniating cerebral mass the size of a walnut was present. There were no other wounds about the head or body. There was noted to be a left homonymous hemianoptic field defect with some encroachment into the right lower quadrant. There was slight left-sided weakness with increased reflexes. X-rays of the skull showed a right occipital defect with ill-defined borders and fragments of the bone in-driven to a depth of $2\frac{1}{2}$ inches (figs. 1 and 2). A metallic body was imbedded in the region of the right motor cortex.

A total debridement of the occipital wound was carried out under local anesthesia. The edges of the skull defect showed gross evidence of infection. The area was enlarged until normal bone was encountered. The herniating cerebral fungus and the in-driven bone fragments were removed as completely as possible. The existing severe visual-field defect tended to limit the extent of the debridement. As a result, although five chips ranging from $1\frac{1}{2}$ by 1 cm. to 1 by $\frac{1}{2}$ cm. in size were removed, postoperative check-up films revealed evidence of small chips having been left behind.



3. (CASE 1). A POSTERIOR-ANTERIOR VIEW FOLLOWING REMOVAL OF THE SHELL FRAGMENT WHICH SHOWS THE RIGHT PARIETAL BONE FLAP LYING IN PLACE.

The patient's postoperative course was uneventful. Mental improvement was apparent, but no change was noted in his visual fields. Two weeks later a small right parietal bone flap was turned. The bone was unusually vascular and the dura in places was adherent, necessitating the use of the rongeur instead of the Gigli saw. The subarachnoid space was partially obliterated by fine arachnoid adhesions. The cortical vessels were increased in number and size particularly in the area lying directly over the foreign body. On palpation of the cortical surface a definite sense of resistance was noted corresponding to the preliminary markings of localization. The body was found $1\frac{1}{2}$ cm. below

the cortical surface. It measured $1\frac{1}{4}$ by $\frac{3}{4}$ cm. Figure 3 is a posterior-anterior skull film taken postoperatively. The right parietal bone flap can be seen in place. The postoperative course was uneventful, the patient improving rapidly both mentally and physically. The weakness of the left side became less marked and he was able to walk without noticeable impairment. Repeated visual-field examinations showed little change. The patient was discharged to the United States on January 3, 1943, 7 weeks following admission.

This case offers some indication of the degree of penetrating force a shell fragment even as small as this one may possess. Fortunately the amount of cerebral trauma sustained, as elicited by neurological examination, excepting the visual-field impairment, was slight. Ordinarily, the advisability of attempting to localize and remove a foreign body of this size would be open to question. However, since it was near the surface and in the region of the motor cortex, removal was justified. As a rule foreign bodies similar to this one should be let alone, unless there is some relationship to the patient's immediate condition or the chance of future trouble is pretty much assured. This patient's prognosis may be tinged with doubt. Epilepsy must be considered strongly and will remain a threat for years. On the other hand it is logical to assume that the removal of the fragment has tempered that chance somewhat.

Case 2.—A 23-year-old marine was wounded on Guadalcanal on December 27, 1942, by a high-velocity bullet which penetrated his helmet, grooving the vertex to the left of the midline. He was unconscious an undetermined length of time. Following initial treatment he was flown to the nearest base and finally admitted to this base on January 6, 1943. On admission it was noted that he was stuporous and disoriented. Examination of the head revealed a gutter-type gaping wound 4 inches in length and 2 inches in width running to the left of the midline anteriorly. The wound was draining and depressed, comminuted bone fragments with protruding necrotic brain were readily visible. Neurologically the cranial nerves showed no gross abnormalities. The peripheral reflexes were slightly increased on the right side but no pathological ones were elicited. Skull films (figs. 4 and 5) show the severity of the comminution and depression of bone fragments which penetrated to a depth of $3\frac{1}{2}$ inches. The patient was transfused and a total debridement was carried out. During the procedure 26 pieces of bone were removed. The largest fragment measured $1\frac{1}{2}$ by $1\frac{1}{2}$ cm. The wound was closed without drainage.

Postoperatively the patient improved rapidly in all respects. A check-up film (fig. 6) was taken which showed that one fairly large depressed fragment was still present. It was felt that it was too large to be allowed to remain. Accordingly a second procedure was done, and after considerable difficulty the bone chip, measuring $1\frac{1}{2}$ by 1 cm., was located. It was firmly attached to the falx and was outside the main tract of entrance. Further films, one of which is shown in figure 7, confirmed that all fragments had been removed. The patient's course continued to be uneventful and the wound healed satisfactorily. He was allowed up and was discharged free of symptoms. The right-sided peripheral reflexes continued to be increased. Figure 8 shows the wound shortly before the patient was returned to the United States.



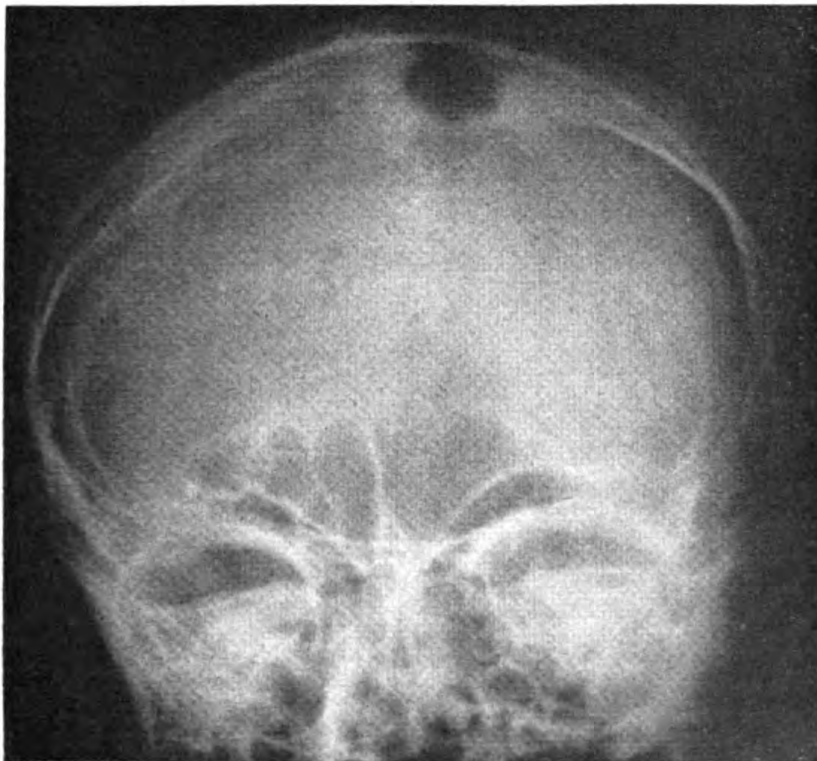
4. (CASE 2). A POSTERIOR-ANTERIOR FILM WHICH SHOWS THE GUTTER-TYPE SKULL FRACTURE WITH COMMINATION AND DEPRESSION OF THE BONE FRAGMENTS. SMALL METALLIC FRAGMENTS ARE ALSO PRESENT.



5. (CASE 2). A LEFT LATERAL FILM WHICH SHOWS THE DEPTH OF THE DEPRESSED BONE FRAGMENTS AND THE REGIONS OF THE LEFT FRONTAL LOBE INVOLVED.



6. (CASE 2). A LEFT LATERAL FILM WHICH SHOWS A RETAINED BONE FRAGMENT FOLLOWING THE FIRST OPERATION.



7. (CASE 2). AN ANTERIOR-POSTERIOR FILM WHICH REVEALS THE EXTENT OF THE SKULL DEFECT FOLLOWING A SECOND OPERATION. ALL DEPRESSED BONE FRAGMENTS HAVE BEEN REMOVED.

This case illustrates one effect of a high-velocity projectile on the skull. Undoubtedly the helmet saved this patient's life in that it caused some degree of upward deviation of the bullet. The result was a gutter type of wound furrowing the skull and brain. The principal damage to the brain was due to the shattering force against the skull comminuting both tables and forcing the fragments deeply into the frontal lobe. Frequently, as was so in this case, the fragments will not all lie within the direct tract, but may be scattered considerably, thus increasing the difficulty in location and removal. Also it is a certainty that there are always many more fragments present than one would suppose from the x-ray evidence.



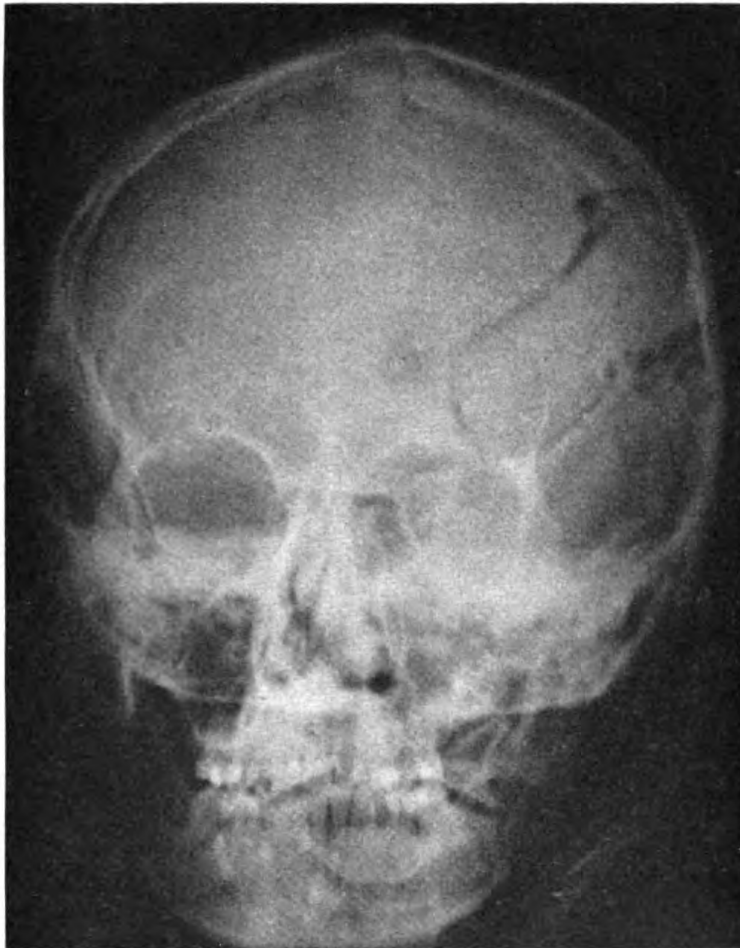
8. (CASE 2). TAKEN SHORTLY BEFORE THE PATIENT RETURNED TO THE UNITED STATES.

Case 3.—A 25-year-old soldier was wounded in the head on Guadalcanal November 16, 1942, by machine-gun fire. A debridement of the wounds was performed following which his general condition improved sufficiently to warrant further transportation. He was admitted to this base 3 weeks after his injury, in a serious condition. He could be aroused but his mental capacity was impaired to the point that he was unable to recall any facts concerning his present illness.

Examination of the head revealed a large defect in the scalp and skull in the right temporoparietal region. There was a herniating mass protruding from this defect the size of a small orange which was draining profusely. A second smaller closed wound was present involving the right supraorbital ridge $2\frac{1}{2}$ inches in length. The surrounding skin and soft tissue were swollen and edematous with the right eye partially closed. There was a left central facial paralysis and the entire left side was hemiparetic. The peripheral reflexes were increased on this side and there was a positive Babinski. Several films taken at a previous base were sent with the patient. Figure 9 is a posterior-anterior view taken about 1 week following the injury showing the entrance wound with comminution of the right vault. Figure 10, taken at the same time, is a right-lateral film showing the exit wound in the right parietal bone. Figure

11 is an attempt at a posterior-anterior view taken shortly after admission. One portable film only was taken due to the patient's poor condition. The osteomyelitic process around the wound entrance and the loss of some parietal bone, the result of a previous debridement, is clearly discernible.

A total debridement was performed. The entrance and the exit wounds were connected. As suspected, there was an extensive osteomyelitis involving the entire area between both wounds. A large brain abscess was found in the right frontal lobe lying 2 cm. beneath the cortical surface. The cavity contained



9 (CASE 3). A POSTERIOR-ANTERIOR VIEW TAKEN 1 WEEK AFTER BEING WOUNDED. THE BULLET ENTRANCE IN THE RIGHT SUPRAORBITAL REGION AND THE COMMINUTION OF THE SKULL ARE SEEN CLEARLY.

about 75 cc. of pus. It was well walled off and did not connect with the exit wound. A second much smaller abscess was encountered in the right temporo-parietal region situated below the cerebral fungus. The scalp was laid back widely and both abscesses were drained. The cerebral fungus was allowed to remain. Sulfanilamide powder as in all the cases was applied locally. Post-operatively, the patient's course was stormy. The cerebral herniation increased but on the fifth day he was distinctly improved, with the temperature dropping from 104° to 101° F. The herniation tended to recede as the abscesses healed. Figure 12 is a film taken 6 weeks postoperatively. It shows the extent of the

bone debridement required at the time of operation due to the bone infection. New bone is beginning to be laid down.

Five weeks following the debridement the first plastic procedure was performed. The scalp surrounding the herniation was undercut extensively and the heavy scar connecting the frontal area was excised. The scalp was then approximated over the herniation, reducing the exposed part by one-half. Figure 13 shows this area 2 weeks later. It may be noted that the fungus has almost receded completely. Figure 14 was taken approximately the same length of time following a second similar procedure and just before the patient was returned to the United States. He was discharged on February 15, 1943, and



10. (CASE 3). A RIGHT-LATERAL VIEW WITH THE EXIT WOUND SEEN IN THE LOW PARIETAL AREA.

at the time walked without difficulty. He continued to have weakness of the left lower face. The left-sided reflexes were increased over the right with slight impairment in motor power.

DISCUSSION

During the First World War according to statistics compiled by De Martel and Vincent, the mortality rate of major gunshot wounds of the head approached 60 percent. There appeared to be a definite relationship between this excessive figure and infection. The time element was an important factor, and it was proven that as the in-



11. (CASE 3). A PORTABLE POSTERIOR-ANTERIOR TAKEN ON ADMISSION, 2 WEEKS LATER THAN FIGURES 9 AND 10.



12. (CASE 12). A RIGHT-LATERAL FILM TAKEN 6 WEEKS POSTOPERATIVELY. THE EXTENT OF BONE DEBRIDEMENT AND NEW BONE FORMATION CAN BE SEEN.

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terval lessened from the time of injury and operative intervention, the mortality rate was reduced. This series of cases may be placed on a similar basis in that on admission they have been major problems due to the complications of infection rather than due to the initial trauma. So great a difference cannot be ignored and probably that



13. (CASE 3). TAKEN 2 WEEKS FOLLOWING THE FIRST PLASTIC OPERATION. THE HERNIATION HAS ALMOST ENTIRELY RECEDED.



14. (CASE 4). TAKEN 2 WEEKS FOLLOWING THE SECOND PLASTIC OPERATION.

difference is associated with more adequate fundamental therapy. Certainly the role of chemotherapy cannot be overemphasized. Also bases near enough the front which have provided facilities for necessary surgical treatment have enabled plane transportation to alter the time factor.

In this series from the beginning sulfanilamide powder had been applied locally supplemented by some form of parenteral administra-

tion. Sulfadiazine has been used principally. Such prophylactic treatment has not eradicated infection as is evidenced here, but may have suppressed or hindered any rapid progression. As noted above, no statistics are available concerning the percentage of head wounds, or what is more important, the percentage of those wounds which have become infected. It may be assumed that the number of cases complicated in this manner is definitely less than has occurred before the general use of the sulfa-compounds. New preparations have increased promise but at the present writing the best results so far have been obtained with the use of sulfanilamide in powder, not granular form, locally, and sulfadiazine given by mouth. Transporting the wounded by plane has proved its worth. The patient with a minimum waste of time is brought where he can receive uninterrupted adequate treatment. One criticism is that in some instances patients have been moved too frequently from smaller bases to others. It is a fact that this type of case stands transportation better preoperatively than he will within a few days postoperatively. Ideally then it would be preferable for serious casualties to be removed a sufficient distance from the combat zone in one step so that further removal before the convalescence stage has been reached will not be necessary.

SUMMARY

A series of 12 cases of major gunshot wounds of the head has been presented. On admission to this base, 10 of the cases were complicated by severe infections. All underwent surgical intervention and there were no deaths. For the purpose of emphasizing particular points, three of the cases have been reviewed briefly, and the differences in treatment as compared with similar ones during World War I have been mentioned.



VITAMINS AND FATIGUE

It appears that individuals suffering from deficiencies of the vitamin B-complex tire easily and show greatly diminished ability to do work. This is true even if the deficiency is mild and not accompanied by frank clinical manifestations. The administration of B-complex vitamins to such individuals causes them to lose their lassitude promptly and makes them much more efficient workers. The feeding of B-complex vitamins in excess of the recommended allowances does not, however, increase the physical ability of normal individuals. It appears that men doing hard physical labor even for a few days have an imperative need for an adequate daily intake of the vitamin B-complex if physical fitness is to be maintained.—The Nutrition Foundation, Inc.: Vitamins and fatigue. Nutrition Rev. 1: 227-229, June 1943.

FILARIASIS IN DEFENSE FORCE, SAMOAN GROUP

PRELIMINARY REPORT

JAMES G. DICKSON
Captain (MC) U. S. N.

ROBERT W. HUNTINGTON, JR.
Lieutenant Commander (MC) U. S. N. R.

and
SAMUEL EICHOLD
Lieutenant (MC) U. S. N. R.

The authors of this report are the members of a board created by the Commanding General with direction and full authority to investigate all phases of the subject. The board was specifically directed to make "a careful survey and study of the prevalence of filariasis in the native population of the islands in the Samoan group, including the sources of infection and all factors involving the danger of communication of this disease to personnel of this command." It is therefore convenient and logical to begin with the pertinent data on the prevalence among natives of infection with *W. bancrofti*, and the likelihood of the transmission of this parasite to troops.

Studies of natives of the island of Tutuila made by the senior member before the establishment of the board showed that out of 1,839 examined, 251, or 13.6 percent had microfilariae demonstrable in ordinary thick blood films. Blood smears were examined from 244 children of 5 and under, very few of this group being under 1 year. Microfilariae were found in 4, or 1.6 percent. Since the average time of exposure of this group was approximately 3 years, it is apparent that the chance of finding the embryos in the blood of individuals exposed for only a year or so must be remote indeed.

It is probable that this "microfilarial index" is much lower than the actual percent of the population which has been infected with *W. bancrofti*. This somewhat categorical statement is supported by the following considerations:

1. The chances of finding microfilariae in a blood smear are slight, unless the total number in the circulation is enormous. It is not known how many fully productive female adults would be required to produce such a number.

2. Fibrosis, inflammation, or unknown factors may hinder access of microfilariae to the tissues and circulation. Thus in the case of a native with hydrocele recently observed, microfilariae were numerous in the hydrocele fluid but could not be found in the blood. In a patient studied by O'Connor, microfilariae could not be found in the blood or in tissue sections, even though an excised gland contained four adult females, apparently alive and in full production.

3. Unless there is an unknown factor which gives the adult male and female an indication of each other's location, the number of adults of both sexes in the host's body might be considerable before the chance of a mating is very strong. In any case there is possibility of infection with a solitary male or female.

4. The adult worms are fragile, and prone to death and disintegration.

5. Available data suggest that the mosquito vectors are relatively effective. Our own studies on dog infection with *Dirofilaria immitis*, closely related to *W. bancrofti*, and, according to present evidence, also transmitted by mosquitoes, show that approximately three out of four dogs harbor adult *D. immitis* and that the uninfected are practically always those with very large thymuses, i. e., the young. Approximately one dog out of four shows enormous numbers of these parasites. Thus despite the dog's hair and thick skin, the transmission of *D. immitis* is evidently quite effective. Now it is easy to find natives with enormous numbers of circulating microfilariae of *W. bancrofti*, and there is nothing to indicate that local mosquito vectors are ineffective. Even if, on the average, only 1 bite in 10,000 resulted in the transmission of a filaria, few, if any, Samoans could grow up without harboring filariae at some time.

No studies have yet been attempted on the incidence of clinical manifestations of filariasis among Samoans. It is perhaps questionable whether one could obtain sufficiently reliable histories to justify the trouble.

O'Connor states that:

The usual method of determining the incidence of filariasis in any area is to add to the percentage of inhabitants showing clinical manifestations of the disease the percentage of other persons found to have microfilariae in the blood. The sum of these percentages constitutes the total incidence.

He cites two surveys in Puerto Rico, one made by himself, the other by Hoffman, Marin, and Burke. A striking feature of both these surveys was the relatively small number of persons who had both clinical symptoms and demonstrable microfilariae. Thus the latter workers examined 4,590 persons, and found evidence of infection in 483. Microfilariae were found in the blood of 275, while 208 had clinical manifestations only. Only 14 had both clinical manifestations and microfilariae. O'Connor's own survey gave similar results.

Such figures might at first cause one to doubt whether the symptoms and pathological processes conventionally ascribed to *W. bancrofti* were actually due to this parasite. In this area one frequently sees a native, apparently in perfect health, with blood teeming with microfilariae, and another with some clinical picture ascribed to filariasis, but without microfilariae in the blood. Thus it appears that *W. bancrofti* may, at least temporarily, exist in the body as a saprophyte. The evidence that it can function as a pathogen, while not absolutely conclusive in the Koch's postulates sense, is nevertheless extremely impressive. The remarks of Buxton toward the end of a chapter establishing significant, though not very striking, correla-

tions between the presence of microfilariae and certain physical signs, seem to merit quotation.

We must realize that there are two alternatives for an adult filaria; either it leads a normal life in the lymphatics and pours its larvae into the blood without causing any damage to man; or else an abnormal blockage exists between the adult worm and the opening of the thoracic duct into the venous system, in which case these particular larvae do not reach the circulation, and the blockage produces, or assists in producing, an enlarged gland, or hydrocele, or other physical sign. In fact the larvae which are counted in the blood come from a parent which is causing no physical sign.

Now it would seem almost impossible for filariae to function as pathogens, and in particular to produce the so-called acute filarial lymphangitis described in the textbooks, unless there were circumstances in which these worms functioned as tissue irritants. The notion that filariae produce damage by mere mechanical blockage has little to recommend it, for to produce mechanical blockage without inflammation, in view of the richness of lymphatic anastomoses, would require a prodigious number of parasites. O'Connor's histopathologic studies constitute strong evidence that filariae do produce tissue irritation. He attributes acute tissue changes to disintegrating worms, and postulates an allergic sensitization to 'the worms' substance.

Before leaving the subject of the incidence of infection with *W. bancrofti* one should note O'Connor's statement that "Examination (i. e., tissue examination) of apparently normal persons in endemic areas indicates that practically all the inhabitants are infected with a few or many *Wuchereria*."

From what has been said it is clear that our failure to find microfilariae in the blood of troops in this area does not prove that these troops cannot be infected with *W. bancrofti*. While in Dickson's series the youngest individual found to have microfilariae was 18 months old, and the microfilarial index was very low up to 5 years of age, these observations do not prove that 18 months to 5 years are required for the development of an adult parasite, or of clinical manifestations of filariasis. Accordingly, in attempting to estimate "the danger of communication of this disease to personnel of this command" one must be guided by other evidence.

From the standpoint of opportunity for exposure of military personnel to filariasis, conditions in this area have been novel, perhaps unique. It was necessary to quarter troops in native villages. Mutual curiosity, and the necessity for friendly relations, have brought about close contact between the two races. A great deal of construction, stringing of telephone lines, and brush clearing has had to be done by the troops. Training has involved day and night marches through areas full of mosquitoes and close to native plantations and villages.

It has been a generally accepted tradition that many years of exposure must elapse before the development of clinical filariasis. This tradition seems to be based in large part upon the time required for the white man to develop elephantiasis in the tropics. The possibility of acute filarial manifestations in the white man has received but little attention. Buxton's description of *mumu* or acute lymphadenitis and lymphangitis is of great interest. Since Durkin et al, did not have access to Buxton's work when their report was written, the parallelism between their description of acute lymphadenitis and lymphangitis, and that given by Buxton, is extremely striking. Buxton believed, though he was unable to prove, that *mumu* was caused by filariasis, and that it was the earliest manifestation of the disease. He noted that the *mumu* might come on within a few months of arrival in Samoa, that the trouble frequently commenced in the epitrochlear gland, that the lymphadenitis preceded the lymphangitis, and that the lymphangitis was centrifugal. He also mentioned inflammation in the scrotum.

In view of the conditions under which troops have had to be quartered, it would seem most probable that many would be bitten by filaria-containing mosquitoes and would harbor adult filariae in their tissues. That this actually is the case has been shown by one of us (J. G. D.) in dissections of lymphatic tissue removed at operation from patients with *mumu*. Tissues have been examined from 17 cases; in 6 of these adult filariae or large fragments have been found. In 2 of these cases the worms were alive after extrication from the tissues. Further studies of this material by the serial section technic are in progress.

In view of the technical difficulties of the procedure, and the fragility of the worms, this is as high an incidence as one could expect. It is likely that in some, and perhaps many instances, the worm found was not the cause of the lesion, that the cause of the lesion (if a worm) had already disintegrated. Nevertheless, these findings afford striking corroboration of the belief of Buxton, and of Durkin et al., that the *mumu* is actually of filarial origin. To disprove this concept would require either a demonstration of some other agent as the cause, or proof that filariasis, despite the evidence of O'Connor and of most other authorities in the field, is incapable of causing lymphangitis.

It is of interest that one patient in whom a worm was found had been but 5 months in the area. Another, who had been here 9½ months prior to the finding of the worm, is of particular interest because, born and reared in Colorado, trained in San Diego, he had never been at Parris Island, or in Louisiana, and had never been in the tropics before.

Histopathologic studies of tissues removed from Marine patients with *mumu* will be presented in the board's final report. At present it can be stated that histopathologic pictures have been found which correspond to those described by O'Connor, and in them structures which are probably disintegrating and calcifying worms. It should be emphasized that while the identification of large dissected fragments of worms of either sex, or of cross-sections of live adult females is a relatively simple matter, the positive identification in tissue sections of worms which are not fully developed, or are undergoing disintegration or calcification, requires considerable study and experience.

CLINICAL CHARACTERISTICS

The clinical characteristics of the lymphangitis which the board believes to be filarial have been discussed in a report from the mobile hospital dated October 18, 1942. The points stressed were:

1. The disease was seen only in troops with 5 months or more in the area.
2. The progress of the lesion, which, in an extremity, usually started with a lymphadenitis then continued as a retrograde or centrifugal lymphangitis.
3. The highly characteristic type of scrotal involvement, with funiculitis.
4. The absence of cutaneous or urethral infection.
5. The tendency to multiple involvement and recurrence.
6. The absence of severe constitutional symptoms.

The disease was particularly troublesome from a military point of view, because, though producing little acute prostration, it often left the patients incapacitated for strenuous duty for a considerable period of time. In his discussion of *mumu* Buxton notes the genital lesions only in passing; he attempts no description of these lesions. Otherwise as already noted, there is close correspondence between his account of *mumu* and that of Durkin et al. Subsequent experience has indicated the need for but slight modification in the latter description. The data from Wallis Island record two cases developing 1 month after arrival. Unfortunately clinical notes on these cases were not available for review, and it is not known whether these men had had previous tropical duty. However, *a priori* it is quite possible that this lesion might develop within a short time after arrival, and it is perhaps significant that exposure was evidently much heavier in Wallis than in the other islands, where no such precocious cases were observed. The lesions of the extremities show a little more variability than was indicated by the original report. Thus the process may start in the epitrochlear rather than the axillary region. We believe that if the lesion involves principally the deep lymphatics, there may be no visible red streaks.

From the hospital experience to date it appears that the scrotal structures are the most common site of involvement. For conven-

ience, funiculitis, epididymo-orchitis, and edema of the scrotal skin, will be collectively designated as scrotal lesions. Funiculitis of some degree was a constant finding in patients with involvement of the scrotal structure and might or might not be associated with epididymitis, orchitis, symptomatic hydrocele, and edema of the skin of the scrotum. It may be that the hospital experience was somewhat biased, since the scrotal lesions undoubtedly caused more disability than did those of the extremities, and they seldom offered any difficulty in differential diagnosis, whereas it is possible that some of the lesions of the extremities which were excluded from the lymphangitis category because of atypical behavior, or skin infection, actually belonged to this entity which we now consider filarial.

TABLE 1.—*Showing anatomical distribution in 251 cases of acute lymphangitis*

Patients with unilateral scrotal lesions only.....	95
Patients with unilateral arm lesions only.....	45
Patients with unilateral leg lesions only.....	4
Patients with bilateral scrotal lesions only.....	33
Patients with bilateral arm lesions only.....	11
Patients with bilateral leg lesions only.....	3
Patients with multiple involvement:	
Scrotum and arm.....	49
Scrotum and leg.....	6
Scrotum, arm, and leg.....	2
Arm and leg.....	3

The distribution of the lesions in 251 patients seen at the mobile hospital between September 1, 1942, and February 1, 1943, and returned to the United States on medical survey is given in table 1. It will be noted that of 185 patients with scrotal involvement, 57 or 30.8 percent had involvement of the extremities as well. *Prima facie*, this would appear to be a striking association. In this group, neither funiculitis nor lymphangitis of an extremity was recorded in patients who had less than 4 months in the area. This in itself is evidence for a relationship between the two processes. However, it renders absurd any attempt to calculate a correlation coefficient without knowledge as to the actual number of population at risk, i. e., of troops with 4 months or more of residence in the area and this figure is not available. Nevertheless, even if one were to assume that the incidence of lymphangitis of the extremities were as high as 10 percent in the population at risk, an incidence of 30 percent in those with scrotal lesions gives a difference of approximately eight times the standard deviation. It is clear, therefore, that the association between the lesions of the scrotum and those of the extremities is statistically significant, i. e., not attributable to random sampling. Moreover, in some instances it has been possible to observe a "retrograde" progression of

the funiculitis, comparable to that of the lymphangitis of the arm. We have also observed that a number of patients with scrotal lesions and with no history of lymphangitis show enlargement of the epitrochlears, which Buxton considered one of the more important physical signs of filariasis in this area. Then, too, in one case in which epididymovasectomy was thought indicated, the histologic character of the lesion in the epididymis was quite comparable to that of lesions in tissues removed from arms. Thus, though for obvious reasons we have been unable to make a systematic search for worms in genital tissue, we feel that there is an almost overwhelming presumption that the scrotal lesions have the same etiology as those of the extremities.

In this series the relative scarcity of lesions of the lower extremities is of some interest. Thus such lesions were recorded in only 17 patients, all but 7 of whom had involvement of other structures as well. We have seen a number of cases of a lesion of the foot resembling giant urticaria. These, and other nondescript lesions of the leg, have all to be excluded from the "lymphangitis" category. It is possible that some of these lesions may have been filarial, and hence that our figure for leg involvement in filariasis is too low as a result of diagnostic conservatism. Nevertheless we feel that among our troops the leg was involved much less frequently than either the scrotum or the arm. Possibly the long trousers worn by most of the men who left their shirts off may have protected the lymphatics of their lower extremities against the introduction of filariae, while the lymphatics of the arm and the deep abdominal lymphatics leading to the spermatic cord were not protected.

TABLE 2.—*Showing anatomical distribution of elephantiasis in 131 male cases (from Buxton)*

DISTRIBUTION			
Single :		Multiple :	
Scrotum.....	51	Scrotum and leg.....	12
Leg.....	17	Scrotum and arm.....	4
Arm.....	8	Scrotum and penis.....	5
Paired :		Scrotum, leg and arm.....	13
Two legs.....	13	One arm and one leg.....	3
Two arms.....	3	Scrotum, leg, penis.....	1
Two legs and two arms.....	1		

With these considerations in mind, it is interesting to compare the figures in table 1 on the distribution of lesions in 251 patients with acute lymphangitis, with Buxton's figures on the distribution of lesions in 131 male patients with elephantiasis (table 2). Buxton noted that elephantiasis of the scrotum was always bilateral and made the reasonable assumption that if only one side of the scrotum were

affected by an obstructive process, collateral lymphatic circulation through the other side would be sufficient to prevent elephantiasis. In Buxton's series the leg was more commonly involved than the arm. This may be due in part to mechanical factors favoring the development of edema in the leg as well as to the native's lack of protection against bites in this region. However, for our present discussion the most interesting feature of Buxton's table is its evidence that in elephantiasis among males in this part of the world, the scrotum is the region most commonly involved. It is noteworthy that Buxton's figures for involvement of the scrotum in elephantiasis do not differ greatly from ours for involvement of this region in acute lymphangitis. The relevant figures are given below:

	Number of patients	Total with scrotal involvement		With involvement of scrotum alone	
		Number	Percent	Number	Percent
Elephantiasis (Buxton).....	131	86	65.7	51	38.9
Acute lymphangitis.....	251	185	73.3	128	51.0

The importance of filariasis in the development of hydrocele in Samoa, and the high prevalence of this lesion, have been stressed by Buxton and other authorities. Dr. Stowers, of the Samoan Hospital, tells us that he sees every gradation between simple hydrocele of the scrotum on the one hand and frank elephantiasis on the other. Thus there are many reasons for believing that the scrotal structures are particularly prone to involvement in both acute and chronic lesions of filariasis. O'Connor's studies in Puerto Rico emphasize the frequency with which adult *W. bancrofti* could be found in the cord and epididymis.

A striking symptom in many of our patients was the depressed mental state. O'Connor has made similar observations. This depression persisted even after the good prognosis had been explained and apparently understood. It was therefore probably not due entirely to psychological factors.

Skin tests.—The mobile-hospital workers noted that the "Samoa lymphangitis" suggested a sensitization reaction in appearance and evolution. They felt that the lesion was readily explicable on the hypothesis of sensitivity to an antigen being released in a lymph node or channel. This hypothesis was, in essence, O'Connor's concept of the genesis of acute filarial lymphangitis. Taliaferro and Fairley had reported favorably on the diagnostic value in human filariasis of skin tests with extract of the dog heart worm, *Dirofilaria immitis*, which is closely related to *W. bancrofti*. Since skin tests with extract of *W. bancrofti* were impracticable on account of the small bulk of

material available, it was decided to try skin tests with extract of *D. immitis*, in the hope of shedding light on the pathogenesis of our "acute filarial lymphangitis" and of developing a diagnostic aid. Detailed description of technic and analysis of results will be given in a paper to be published later. The total maximum dose and the volume of fluid injected were considerably less than those advocated by Fairley, since it was found that dosage approximating his gave extremely severe and uncomfortable 24-hour reactions in patients with *mumu*. After some experience, a positive reaction was defined as one characterized by an immediate wheal, irregular in outline during its development, and reaching a diameter of 15 mm. or more (positive immediate reaction), and by a 24-hour edema measuring at least 30 mm. in diameter with the full-strength extract, or at least 20 mm. with diluted extract (positive 24-hour reaction). A delayed reaction measuring between 20 and 30 mm. to the full-strength solution was recorded as a doubtful delayed reaction.

The essential figures are given below :

		Controls (4 weeks or less in area)	Patients with <i>mumu</i>
Number tested.....		128	137
With positive immediate and delayed reactions.....	{ Number.....	6	114
	{ Percent.....	4.7	83.1
With positive immediate and negative delayed reactions.....	{ Number.....	12	2
	{ Percent.....	9.4	1.7
With negative immediate and positive delayed reactions.....	{ Number.....	0	14.0
	{ Percent.....	0	12.3
With negative immediate and doubtful delayed reactions.....	{ Number.....	4	3
	{ Percent.....	3.1	2.6

The resemblance between the forearm in a severe 24-hour reaction and the forearm in a severe lymphangitis was very striking.

It was noted that the majority of *mumu* patients with negative reactions, including one in whom a worm was subsequently found, were in a very acute phase of the disease, and there was evidence which strongly suggested a desensitization during such a phase.

Individuals with several months' residence, in whom, though lymphangitis was suspected, a definite clinical diagnosis was not possible, showed almost as much an incidence of positive reactions as was shown by patients with the clear-cut clinical picture. Tests on 29 members of the hospital staff without evidence of lymphangitis, who had been here 8 months or more, most of the time with good housing, showed 6 with positive reactions, 5 with doubtful reactions, and 18 with negative reactions.

These observations indicate that the development of symptoms suggestive of filariasis, or long residence in the area without development of clear-cut clinical symptoms, are associated with sensitization to filarial protein. Comparative tests with extract of *Ascaris lumbrici*

coides revealed a certain degree of cross-reactivity between this worm and *D. immitis*, and the *D. immitis* reaction cannot therefore be considered strictly specific for the filaria group. But, since stool examinations in 57 patients with lymphangitis who were skin-tested showed intestinal parasitism in but 8, and ascariasis in but 2, it is not unlikely that in the majority of instances the sensitization had been induced by filariae. One should not rely too heavily on a positive skin test with *D. immitis* as evidence of previous contact with filariae in every case. However, the existence of allergy to filarial substances has been demonstrated in a gross and unequivocal manner and this demonstration affords support for O'Connor's concept of the genesis of acute filarial lymphangitis. In this connection it is of little importance whether the sensitization was induced by filariae or by other agents.

The data collected by one of us (S. E.) from Upolu, Wallis, and Funafuti show quite clearly the association of long residence in the area, and of exposure to mosquitoes in zones of native habitation, with the prevalence of clinical filariasis among troops.

MOSQUITO STUDY AND CONTROL

Detailed studies on mosquitoes and their control will appear in the final report. The mosquito fauna of western Samoa was thoroughly studied about 20 years ago by one of the world's greatest entomologists, Professor Buxton. The board's findings in Tutuila have been in accord with Buxton's in western Samoa. Some six species are abundant here, only two of which are known to carry filariasis—*Aedes variegatus*, a dim-light biter and the principal vector, and *Culex fatigans*, which feeds by night. The breeding habits of these animals are well known. Eggs are laid in small collections of water in natural and artificial receptacles of every description including coconut husks, cans, bottles, rot holes in trees, steps cut into coconut palms, etc. The mosquitoes are domestic in their habits, usually feeding and spending their careers within a few hundred yards of their hatching place. Their breeding can be reduced but eradication is impossible under present conditions. Clearing of underbrush around habitations for several hundred yards serves a twofold function: It opens the area to the breezes to sweep mosquitoes away and it helps reveal numerous breeding places. The breeding places should be eliminated as far as practicable. This is of distinct value, though personal protection is probably of far greater importance.

DIAGNOSIS, PROGNOSIS, TREATMENT AND DISPOSITION

Diagnosis.—It would seem that the diagnosis of filariasis in white troops was no longer a perilous and audacious undertaking, and that this diagnosis should be used in cases similar to those described in the original report from the mobile hospital.

The board does not wish to dictate criteria for the diagnosis of filariasis, or to fetter the medical officer's judgment in any way. We would, however, suggest particular attention to the following points:

1. Length of time in area, with previous tropical duty if any.
2. Mosquito exposure.
3. Propinquity to natives.
4. A history of lymphadenitis followed by lymphangitis.
5. Retrograde (centrifugal) lymphangitis of an extremity.
6. Funiculitis, with or without epididymitis, orchitis, acute (symptomatic) hydrocele, or edema of the scrotal skin.
7. Absence of G. C. or of cutaneous infection of the involved extremity.
8. Recurrence.

Prognosis.—In the majority of instances the acute process will subside after a few days of bed rest. However, we think that men should not, in general, be returned to full duty until 10 days to 2 weeks after an acute attack, since the process has a definitely debilitating effect, and we feel that too early resumption of duty increases the likelihood of recurrence or relapse. However, fresh lymphangitis has occurred in a new site in patients on bed rest. There is no doubt that, on the whole, lesions of the scrotum are more disabling than those of the arm and necessitate a more cautious convalescence. In the Samoan area the likelihood of recurrence is considerable, and we hope to be able to evaluate it more accurately. Although the data are not as complete as could be wished, it is probable that in most instances cessation of recurrences may be expected within a few months of return to the United States. The chance of development of permanent deformity of the extremities is slight, because elephantiasis of the extremities in white inhabitants at Upolu developed only after 15 years of repeated attacks of lymphangitis. However, in three white subjects seen by Dr. Eichold, and in many more on whom he obtained reliable histories, the development of permanent deformity of the scrotum required only 3 years or less. Similarly, O'Connor noted in Puerto Rico that chronic hydrocele could develop after but two attacks of acute funiculitis. It is clear that the prognosis, both immediate and remote, is somewhat more dubious for scrotal lesions than for those of the extremities. From histologic study of the removed epididymis and vas already mentioned, and from observations among Samoans, we feel that in the majority of instances funiculitis, if properly handled, will not lead to sterility.

Treatment and disposition.—For the acute attack, the principal indications are bed rest and reassurance. Sulfonamide drugs have not appeared to be of benefit. Patients with uncomplicated lesions of the arm (first attack) should probably be ready to discontinue bed rest in a few days and to resume full duty within 10 days. Patients with recurrent or multiple involvement, and at least the majority of

those with scrotal lesions, should, we believe, be transferred to a hospital, and it is probable that after further study the majority of such patients will be, and should be, surveyed. Further study may reveal that the incidence of recurrence is so high that all patients should be surveyed after one clear-cut attack.

PSYCHOLOGICAL ASPECTS OF THE PROBLEM

Here we believe that, once the diagnosis is made, the correct line is one of complete frankness. Fortunately, after explaining the nature of the conditions, one can honestly assure the victim that it is a relatively trivial one compared to, say, malaria, or diseases such as tuberculosis or rheumatic heart disease which are much more prevalent in the United States than in the South Seas. One can assure the patient that he will be transferred to the United States if there is any likelihood that keeping him in this area would subject him to danger of permanent deformity. One can therefore honestly assure the patient that the prognosis is excellent, and that the fear which this disease has inspired is due largely to its unfamiliarity. Some fantastic worries which have gained currency, for example, as to the chance of transmission of the disease to wives and offspring, and sterility, can and should be dispelled.

SUMMARY AND RECOMMENDATIONS

The opportunity for transfer of filariae to troops in this area would seem to be considerable, and studies by one of us (J. G. D.) show that such transfer actually occurs. On the basis of present knowledge the highly characteristic type of lymphangitis which has been of common occurrence in the area should be considered filarial. Doubt as to the filarial etiology in these cases would seem to imply doubt as to the pathogenicity of *W. bancrofti* in general. While this doubt cannot be entirely resolved at present, we think the balance of evidence, including our own studies on skin sensitivity to filarial extract, strongly favors the orthodox view on the relation of *W. bancrofti* to human disease. We have made certain recommendations for the diagnosis, treatment, and disposition of filariasis in white troops, and for handling the morale problem. With respect to prevention we believe that shirts and full-length trousers should be worn at all times, that both the screening of quarters and the use of bed mosquito nets should be insisted on, and that special protection (net or repellent) be given men who must work in brush or in marshy areas, close to native habitations. Screened quarters for showing of movies should be provided whenever possible, and men attending open-air movies should use mosquito repellent. The Board is now working on problems of mosquito transmission of filariasis, and on mosquito control, and on diagnostic, clinical, and epidemiological data.

THE PATHOLOGICAL ASPECTS OF ACUTE PHARYNGEAL INFECTIONS

SHIELDS WARREN

Lieutenant Commander (MC) U. S. N. R.

Some of the infectious diseases of the pharynx common in the past have become so rare, as diphtheria, and others have become so important from the epidemiologic standpoint, as streptococcal sore throat and Vincent's angina, that consideration of the pathological lesions occurring in the pharyngeal region appears worth-while. The material will be presented chiefly from the standpoint of gross and microscopic differential diagnosis.

DIPHTHERIA

The characteristic gross appearance of diphtheria is a smooth, sharply defined, white, or pale creamy white, membrane, usually occurring in a single sheet, fairly smooth in outline. The membrane practically always involves at least a portion of the tonsils. Its continuous character and well-defined, fairly even outline are among the most important differential points. At first it may be detached with some ease, but later is quite adherent. As the disease progresses, this membrane, over the course of a few days, becomes first pale yellow and then a deeper yellow. This change in color is due to an increase in the number of fibrin strands which make up the initial membrane as well as to an increasing number of polymorphonuclear leukocytes. Eventually there may be a sufficient number of leukocytes accumulated for partial digestion of the membrane, so that it may be rough and shaggy with some necrotic foci, rather than smooth and white as it was initially. The membrane is closely adherent to the underlying mucosa and when it is separated, small bleeding points appear beneath. The mucosal surface thus exposed is dull, red, and raw.

The most difficult lesion from which to differentiate it grossly is that due to mercurial poisoning, which may usually be readily distinguished because of its characteristic butterfly pattern and its location on the palate. Frequently, in the case of the diphtheritic infection, the patient will be much more ill than the extent of the exudate would seem to warrant, due to the absorption of soluble toxin from the lesion. The edge of the exudate in the case of diphtheria is always distinctly raised above the mucosal surface; that of mercurial poisoning merges imperceptibly with the mucosa. The membrane of diphtheria will extend much more widely than that of any other form of acute pharyngitis; I

have seen cases at autopsy in which the entire tracheobronchial tree as far as the tertiary bronchi was involved. The tonsils, as well as any adenoid tissue which is present, will usually show a fairly marked degree of swelling. As a rule, the cervical lymph nodes will show a moderate degree of enlargement but will not be particularly tender.

Microscopically, the characteristic of the diphtheritic exudate is deposition of fibrin. This is laid down in strands, both in the tissues and on the surface. Frequently, much of the mucosa will remain intact, so that one will see under the microscope heavy agglomerated strands of fibrin, roughly parallel to the surface, overlying portions of mucosa. The strands of the membrane at frequent intervals dip through the mucosa at minute foci and bend sharply downward, becoming continuous with the strands of fibrin in the submucosa. As the disease progresses, the residual islands of mucosa disintegrate. Since there is necrotic tissue present, polymorphonuclear leukocytes and a number of macrophages are attracted to the region involved, and they may accumulate to such a degree that their enzymes will dissolve a fair amount of the fibrin, tending to free the membrane from the surface. It was sheets of membrane freed from the mucosa in this way that formerly constituted such a grave hazard to the diphtheritic patient and necessitated not infrequently intubation or tracheotomy. Those who have read the medical texts of years ago will remember the descriptions of sucking out diphtheritic membranes from the throats of children after the fibrinous exudate had been freed from the submucosa by this digestive action of the leukocytic enzymes. If the membrane is stained to demonstrate bacteria, masses of them will be noted in the fibrinous exudate and in the superficial tissues. As the process becomes older, the formation of small amounts of granulation tissue will be stimulated by the presence of the fibrin at the points where the mucosal epithelium has been destroyed, so that small tufts of granulation tissue may appear. There is an appreciable degree of edema of the submucosal tissue throughout, with hyperemia as an additional feature.

If the lymphoid tissue is examined, for example the tonsil, there will be seen to be very active hyperplasia with abundant mitotic figures in the germinal centers. Numerous macrophages may be seen in the sinusoids, actively phagocytic for lymphocytes, presumably picking up particularly the damaged cells. Owing to the highly diffusible character of the toxin of diphtheria, widespread parenchymatous lesions will also be present. The liver and kidneys show varying changes from cloudy swelling to fatty degeneration or even necrosis. Cardiac necroses—rather specific degenerations of the muscle fibers—may occur, particularly in the conduction bundle, and in addition, an acute interstitial myocarditis will be present. In skeletal muscles there are two changes which may occur—the more common, fatty de-

generation; rarely Zenker's degeneration. There will be, at times, degeneration of the axis cylinders and myelin sheaths of peripheral nerves, not infrequently accompanied by some infiltration of lymphocytes and plasma cells. Regeneration may be complete or may be partial with fibrosis.

Owing to immunization, diphtheria will probably be encountered rarely in the service. However, whenever large groups are present in close quarters, there is danger of the gravis type of the disease¹ developing, against which the usual methods of immunization may not give complete protection.

CATARRHAL PHARYNGITIS

The mucous membrane in catarrhal pharyngitis is swollen, congested, and bright red, frequently with injected small blood vessels clearly visible. There are often multiple, superficial white patches present. These are usually even with the surface, rather than raised, and under microscopic examination are seen to consist of a region of necrosis of the epithelial cells with a few polymorphonuclear leukocytes and strands of fibrin intermixed rather than to be a true superficial exudate. There is usually some mucus adherent over much of the surface. The causative agent is usually *Streptococcus hemolyticus*, but a wide variety of other organisms may be responsible; among them are *Staphylococcus aureus*, pneumococcus, and *B. influenzae*. Ordinarily the inflammatory process does not extend below the submucosa, which is edematous with hyperemic blood vessels and capillaries and with dilated lymphatics.

The edematous connective tissue contains a fair number of polymorphonuclear leukocytes, some of which will penetrate the mucosa and may be present on the surface. The microscopic picture is not unlike that of erysipelas. The chief difference between the two processes is essentially that in the skin the horny layer prevents, in part, the escape of the exudate and thus blebs are formed, while in mucous membrane the horny layer is absent, the exudate escapes freely, and no blebs appear. The systemic alterations associated with acute catarrhal pharyngitis vary with the virulence of the infecting organism. As a rule, no definite pathologic alterations will be detected, although in the more severe cases albuminuria gives evidence of damage to the renal epithelium.

The sore throat associated with scarlet fever may be indistinguishable from that of acute catarrhal pharyngitis. Apparently the chief factors as to whether or not the patient develops clinical scarlet

¹ Robinson, D. T., and Marshall, F. N.: Investigations on gravis, mitis, and intermediate types of *C. diphtheriae* and their clinical significance. *J. Path. & Bact.* 38: 73-89, Jan. 1934.

fever are the amount of erythrogenic toxin produced by the particular strain of streptococcus and the susceptibility of the individual.²

A fortunately rare variety of acute pharyngitis is septic sore throat. This rapidly developing and prostrating disease practically always appears in epidemic form and is believed due to a distinct variety of streptococcus, *Streptococcus epidemicus*.³ The epidemics have been nearly all milk-borne. The lesions may best be described as a more severe and spreading form of acute pharyngitis, which in the more severe cases leads to septicemia and its sequelae, such as endocarditis, peritonitis, and meningitis.

ACUTE TONSILLITIS

This is a process essentially similar to acute pharyngitis, but chiefly restricted to tonsillar tissue. Hyperplasia of the lymphoid tissue may be marked, and often scattered foci of necrosis are present in it. Sometimes the tonsillar crypts are filled with polymorphonuclear leukocytes which have infiltrated from nearby vessels and lymphatics. Masses of these cells, together with some fibrin, account for the small white patches so often seen on the surface of inflamed tonsils. The white plugs, often visible in the openings of the crypts of normal tonsils, are formed of cellular debris, particles of food, masses of bacteria and fungi, as well as some exudative cells.

On microscopic examination, the germinal centers in the lymphoid tissue are at first much enlarged, hyperactive, and numerous mitotic figures are present. As the disease develops, necrosis and polymorphonuclear leukocytic invasion become more marked, strands of fibrin appear in the lymphoid tissue, particularly near the surface, and plugs of fibrin are present in lymphatics and capillaries. As drainage of toxic material occurs to the regional lymph nodes, these enlarge and similar changes to those in the tonsil develop. These may progress to suppuration, often with the development of a draining sinus, or regress, leaving granulation tissue or scarring. With recurring infections, the lymphoid hyperplasia regresses less and less following each period of hyperplastic response, and marked tonsillar enlargement is brought about. A fair degree of fibrosis may develop as healing from the acute attack occurs and ultimately a rather marked degree of connective tissue infiltration will occur in the deeper tonsillar tissues.

The distinction is sometimes made between follicular tonsillitis, in which the hyperplasia and inflammatory reaction are restricted to the

² Topley, W. W. C., and Wilson, G. S.: *Principles of Bacteriology and Immunology*. Second edition. Williams & Wilkins Co., Baltimore, 1941. P. 459.

³ Gay, F. P., et al.: *Agents of Disease and Host Resistance Including the Principles of Immunology, Bacteriology, Mycology, Protozoology, Parasitology and Virus Diseases*. Charles C. Thomas, Springfield, Ill., 1935. P. 473.

tonsillar region, and exudative tonsillitis, in which edema and suppuration are extensive. The variation is chiefly in the extent of the disease.

A fortunately rare complication of acute tonsillitis is the peritonsillar abscess (quinsy). This is usually secondary to streptococcal or staphylococcal infection of the soft tissues immediately underlying the tonsil. In this the essential picture is that of an abscess in soft tissue, with necrosis centrally, with accumulation of both viable and dead leukocytes and bacteria, as well as the products of tissue destruction. The necrotic center is surrounded by a pyogenic membrane of loose granulation tissue with heavy polymorphonuclear, mononuclear, and some lymphocytic infiltration. Owing to its proximity to the great vessels of the neck, jugular thrombosis, blood stream infection, or even erosion of a vessel wall with hemorrhage are ever present dangers.

ACUTE CATARRHAL FEVER

In acute catarrhal fever the throat is diffusely red, with relatively poor demarcation of the inflamed portion from the normal tissues. There is very little swelling other than a somewhat soggy appearance of the mucosa. As a rule no exudate occurs.

The histologic picture is unknown, but probably little more than edema and some hyperemia are present.

The characteristic features are the signs of diffuse and changing pulmonary involvement, often with roentgenologic evidence of patchy pulmonary atelectasis and emphysema.

PHLEGMONOUS PHARYNGITIS OR LUDWIG'S ANGINA

This type of infection is characterized by extensive involvement of the pharyngeal soft parts in an acute inflammatory process. In the typical form of Ludwig's angina, pain, local heat, and edema are present in the sublingual and submaxillary regions. Often the tongue will be so swollen by edema, hyperemia, and exudation that it protrudes between the teeth. Motion of the tongue or muscles of the throat is painful and the ever-present danger is occlusion of the airway as a result of the local swelling with or without laryngeal spasm.

As would be expected with an acute diffuse infection of cellularitic type, the infecting organism is usually the *Streptococcus hemolyticus*, although any of the pyogenic organisms may be involved. Rarely is one type of organism alone responsible. Much of the tissue destruction is attributable to the synergistic action of different bacteria. Vincent's organisms have been found as symbionts in a fair number of cases. The micro-aerophilic streptococcus described by Meleney is not infrequently a factor. The infection may originate from a preexisting infection of the pharyngeal surface from peridental sep-

sis, to extension of infection from osteomyelitis of the cervical vertebrae, from the extension of infection from already involved cervical lymph nodes, or other glandular structures in the neck. Only rarely is Ludwig's angina a primary infection, but usually a sequel to some already established process.

The hazards to the patient are threefold: The direct effect of sepsis with the absorption of toxic products from the involved region, the occlusion of the airway, or partial occlusion of the airway, with accumulation of mucus with the subsequent development of aspiration pneumonia.

In the early stages a rather resilient type of swelling is the chief feature. The adjoining mucosa is bright red but boggy in appearance, sometimes with white necrotic or exudative patches. The superficial tissue may be diffusely infiltrated with polymorphonuclear leukocytes or macrophages. As the leukocytic infiltration becomes more marked, induration is more marked. With the passing of some hours or a few days, the accumulation of toxic products and necrotic tissue may be sufficiently great to produce a retropharyngeal abscess.

The association of phlegmonous pharyngitis with agranulocytosis is sufficiently great to demand a white blood count in every case of severe pharyngitis.

AGRANULOCYTIC ANGINA

This disease is frequently confused with Ludwig's angina. Usually the tonsils are involved by superficial ulcerations, which may be the only local manifestation. At times, however, these ulcerations become extensive, producing deep necrosis or gangrene extending even down to the larynx. The microscopic picture of the involved tissue is distinctive, being almost devoid of polymorphonuclear leukocytes in spite of widespread necrosis and the presence of bacterial masses. The small blood vessels are thrombosed. A moderate infiltration of plasma cells and lymphocytes is the only evidence of active cellular response.

The absence or diminution in number of polymorphonuclear leukocytes in the peripheral blood clinches the diagnosis.

VINCENT'S ANGINA

Vincent's angina is characterized by sharply defined, irregular ulcerations which have a gray base. The base, at first smooth, becomes shaggy as the ulceration deepens. The margins are red, boggy, and, in the later stages, undermined. The ulcers usually appear first on the tonsils or about the teeth. A smear usually suffices to demonstrate Vincent's organisms, the coexisting spirilla, and fusiform bacilli.

THE ABSENCE OF SKIN IRRITANTS IN THE CONTENTS OF VESICLES^{1 2 3}

MARION B. SULZBERGER
Commander (MC) U. S. N. R.

and

J. HARRY KATZ
Lieutenant (MC) U. S. N. R.

Vesicants are agents which produce vesicles or blebs when applied to human skin. Some of these agents, for example the ingredients of plants such as poison ivy, are allergens and produce vesication only after first specifically sensitizing the skin. Other agents, of which cantharides, mustard gas and lewisite are examples, presumably produce irritation and vesication by direct local action without preceding sensitization (primary irritants or primary vesicants). It is of both theoretical and practical significance to establish whether or not the vesicle fluid in both these classes is in turn capable of producing blisters or irritation.

In the first place the determination of the fate of the vesicant, its pathways, distribution, alteration, its persistence or evanescence in the tissues and fluids, are steps toward the elucidation of the pathogenesis of the particular biological reactions.

Furthermore, many practical procedures in the management of patients depend upon the knowledge of whether or not the vesicle fluid contains poisons and vesicant agents. This knowledge will, for example, decide whether or not all blisters and blebs must be opened and evacuated as soon as possible; whether or not the fluid from vesicles must, as far as feasible, be prevented from soiling clothing, dressings, instruments, and other objects and be kept from touching the patient in other areas; whether or not all objects soiled with vesicle fluid must be destroyed or carefully decontaminated; whether or not the medical or other personnel handling the case must be rigorously protected from exposure to vesicle fluid or to objects soiled by this fluid.

Many of these questions are obviously of the most direct practical interest. Thus, if there is no poisonous agent in the contents of blebs produced by chemical warfare agents, then it is obvious that the blister top should not be removed, since the preservation of the vesicle top usually tends to prevent infection and to promote healing. (Of

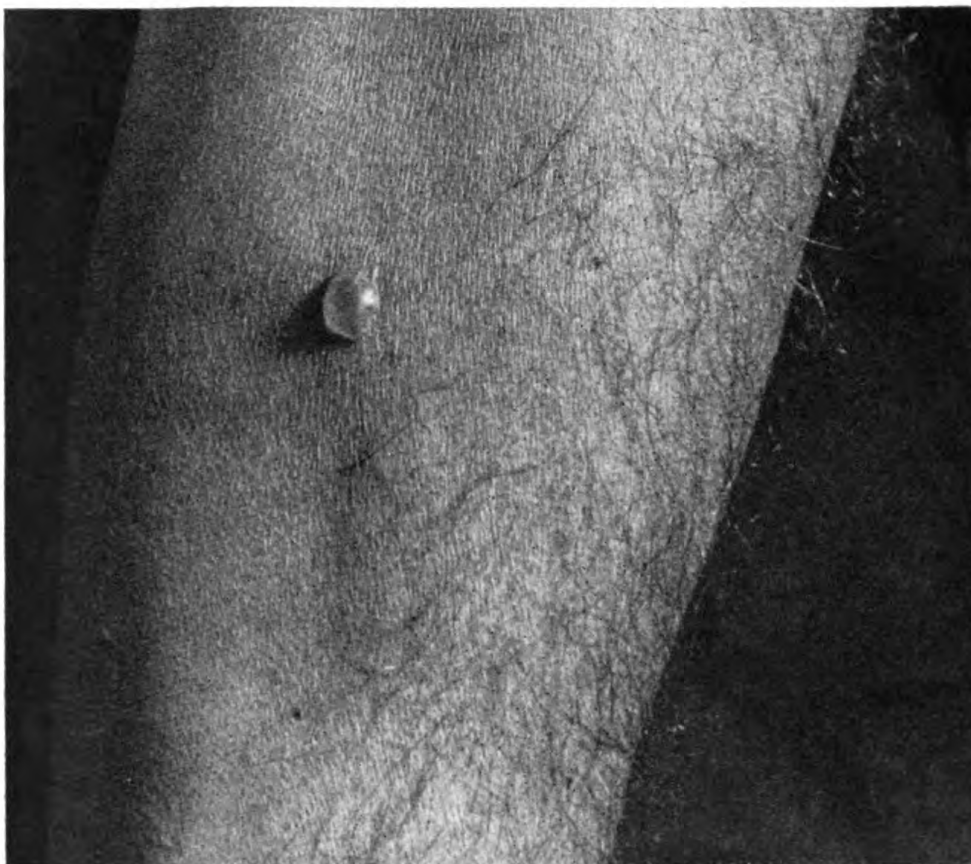
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² From the Department of Medicine, Cornell Medical College, and the U. S. Naval Hospital, Brooklyn, N. Y.

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course the contents of tense and painful blisters should still be evacuated by sterile puncture, and obviously infected blister tops and debris should be removed.)

If the contents of vesicles are not irritant or vesicant, then all the tedious, expensive, difficult, and time-consuming procedures calculated to protect the patient and others from exposure to this fluid become unnecessary. Once the patient's surface has been adequately decontaminated he can be treated as a "clean" case.



1. TYPICAL BLISTER PRODUCED BY LEWISITE ON THE SKIN OF NORMAL HUMAN VOLUNTEER. PHOTOGRAPH 48 HOURS AFTER EXPOSURE TO THE VESICANT.

For reasons such as those just outlined, this report on studies with vesicle fluids and vesicle tops is here presented.

METHOD

Well-developed blisters (fig. 1) were produced on different skin sites of a series of healthy human volunteers by the application of measured amounts of the following vesicants:

1. Poison ivy extract.
2. Liquid mustard gas.
3. Liquid lewisite.

At various intervals after their formation, the contents of the intact vesicles were aspirated with sterile needles and tuberculin syringes. A small piece of cloth was soaked with the aspirated fluid and placed upon normal skin sites, both of the donor individual and of other volunteers. The impregnated cloth was covered with a piece of impermeable material and the two held in place with adhesive (patch test technic). These patch tests were removed at intervals ranging from several hours to 72 hours. The sites were observed for possible reaction at 24 hours, 48 hours, and for 1 week and longer, after removal of the tests.

In many cases the vesicle tops also were removed in toto and placed upon a normal skin area of the donor as a patch test. In some instances the outer surface of the removed vesicle top was placed against the test subject's skin; in other instances the inner surface of the vesicle top was brought against the skin. In most cases both outer and inner sides of the top contacted the skin, as the small piece of tissue usually folded and rolled upon itself under the patch. The majority of the blisters examined by these methods were about 24 hours old. Some, however, were much younger. In these instances the volunteers themselves watched the sites, and fluid was aspirated at the earliest possible time. In this way we obtained material from several vesicles only $\frac{1}{2}$ hour to $4\frac{1}{2}$ hours old.

RESULTS

1. *Poison Ivy*.—Over 25 vesicles produced by poison ivy extracts were examined. In no instance did the vesicle contents produce the slightest irritation either in the donor, or in other test subjects, all known to have skins extremely sensitive to poison ivy. In addition to these vesicles deliberately produced for experimental purposes, the blister fluids from several actual clinical cases of severe poison ivy dermatitis were examined in a similar fashion. In no instance did the fluid produce vesication or irritation.

In these experiments no irritant or vesicant substances were demonstrable in the vesicles of either experimental or clinical poison ivy dermatitis. It is a commonly held belief that the secondary or delayed lesions so frequently seen in clinical poison ivy dermatitis are due to the breaking of vesicles and the contamination of hands, clothing, etc., and eventually of new skin areas with vesicle fluid. Our results indicate that the secondary spreading of the dermatitis is not due to contamination with vesicle fluid but to some other mechanism.

2. *Liquid mustard gas*.—Nine vesicles produced by liquid mustard gas were examined. In no instance did the vesicle contents produce the slightest irritation either on new skin areas of the donors or on the skins of other test subjects.

In these experiments no irritant or vesicant substances were demonstrable in the contents of vesicles produced by mustard gas. This finding is in agreement with previous experimental and clinical experience; and with the general statements in the literature to the effect that the vesicle fluid from mustard gas burns is not irritating and requires no decontamination.

3. *Liquid lewisite*.—Thirty-four experimental vesicles produced by lewisite were examined (fig. 1). Twenty-five normal adults volunteered as test subjects. In no instance did the vesicle fluid or vesicle tops produce the slightest irritation or vesication either on skin areas of the donors or on the normal skins of other subjects.

This finding is in apparent disagreement with the popular concept that the vesicle fluid of lewisite blisters is in itself vesicant. Even the most recent literature on the subject contains many statements to the effect that the blister fluid is vesicant and poisonous.⁴ And most modern summaries and directives in all countries include detailed admonitions regarding the necessity for opening all blisters to allow the drainage of the "poisonous" material. Moreover almost all authors give directions for preventing any of the escaping fluid from touching or contaminating new skin areas in the patient, or from touching clothing, bedding, utensils, or the skin of the attendants. The statement is usually made that this escaping fluid contains the same arsenical as the original vesicant gas, and that absorption of, or external contact with, this vesicle fluid will cause grave injury. Some authors state that even a small amount of this material will be fatal if it reaches the blood stream through any route; and advise that when the blisters have broken, and if the patient still shows signs of arsenical poisoning, the entire area must be widely excised.

The only statement which was found which contradicted this general concept and which agreed with our experimental results, is the following, cited from a recent article by Leon Goldman:⁵

Although the cloudy fluid of the lewisite blister is supposed to contain arsenic, we have not been able to detect arsenic, with sensitive methods by analyzing the contents of the 24-hour and older blister. In one instance the cutaneous cap of the blister was included in the analysis. We have not examined blisters less than 24 hours old. It has been our experience also that this blister fluid of the older blister is not irritating to the adjacent skin nor to the skin of other individuals. This material was applied to other individuals by the patch test technic.

⁴ Since the preparation of this report Lt. Col. John R. Wood stated in a personal communication to the authors that experiments with the contents of lewisite vesicles performed under his direction at Edgewood Arsenal have elicited results corresponding to those here reported.

⁵ Goldman, L.: Some medical problems of vesicant chemical warfare agents as affecting civilian populations. Bull. New York Acad. Med. 19: 57-72, January 1943.

SUMMARY AND CONCLUSIONS

A series of blisters produced on human volunteers by poison ivy, liquid mustard gas, and liquid lewisite, were investigated by application of the vesicle contents and vesicle tops to normal human skin by the patch test technic. The results confirm the general experience that the contents of mustard gas vesicles are not vesicant; and are in contradiction to the popular opinion that the contents of poison ivy vesicles are capable of producing new lesions.

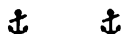
The results with lewisite indicate that the *contents and tops of experimental lewisite blisters are not vesicant*, even when removed from lesions as early as one-half hour after their appearance.

It appears probable that the prevalent concept that lewisite vesicles contain damaging agents is in error, unless it be assumed that the blisters of clinical cases of lewisite damage differ fundamentally in this respect from the experimental lesions here studied.

Further studies on the presence or absence of arsenic in lewisite vesicle fluid are required.

The finding that lewisite blisters contain no irritant or vesicant substances may throw more light upon the mechanism of the vesicular reaction and upon the pathway and fate of vesicants in the skin and other tissues.

Granted that the blisters of clinical and experimental lewisite lesions are alike in regard to their contents, the results of our experiments indicate that the generally advocated removal of all blister tops, the decontamination of all vesicle fluid and of all articles soiled by vesicle fluid, the protection of patient and personnel against further contamination with vesicle fluid are unnecessary and can be dispensed with in the practical management of lewisite casualties. Once the clothing, skin surface, etc., have been decontaminated, the case can then be handled without fear of further contamination.



FIRST-AID METHOD FOR CALCULATING PLASMA DOSE

In many cases in which burns are treated in places remote from hospitals or near the front line in war, plasma may be available yet methods for determining hemoconcentration may not. In such instances the extent of the burn and consequent plasma dosage can be roughly calculated by Berkow's method. For deep burns (arbitrarily, those deep enough to cause blistering), the rule can be adopted of giving 50 cubic centimeters of plasma for every percent of the body surface affected by such a burn. This could also be expressed as a pint of plasma for each 10 percent of the body surface so involved.—Harkins, H. N.; Lam, C. R.; and Romence H.: Plasma therapy in severe burns. *Surg., Gynec. & Obst.* 75: 410-420, Oct. 1942.

LOW BACK PAIN AND SCIATICA

WITH SPECIAL REFERENCE TO ROENTGEN INTERPRETATION

HUGH F. HARE, M.D.¹

and

LESLIE W. LANGS

Lieutenant Commander (MC) U. S. N.

Low back pain and sciatica are common complaints of civilian life, and frequently result in considerable disability. In most instances the complaint dates from some injury to the lower part of the spine. Often the injury results from a simple exertion or fall.

In the military service men often are subjected to stresses and strains and are jolted about more than they commonly are in civilian life. For example, witness the tank corpsmen, paratroopers, dive bomber pilots, and pilots landing and taking off from aircraft carriers. It is not surprising, therefore, that the incidence of low back pain and sciatica in the service should reach such proportions as to warrant special consideration.

Neuritis of sciatic origin or low back pain were not so classified in the Navy nomenclature between 1917 and 1923. However, probably the majority of the cases reported to the Bureau of Medicine and Surgery under the diagnosis of neuritis could be included under this heading. A study of neuritis between 1917 and 1923, inclusive, reveals 875 admissions, resulting in 42,084 sick days, and 20.11 per cent of the patients were invalided from the service (table 1).

TABLE 1.—*Neuritis, 1917-23, inclusive*

Year	Admissions				Invalidings from service	
	Number	Rate per 1,000	Sick days	Average sick days per admission	Number	Percentage of admissions
1917.....	186	0.76	4,947	26.6	24	12.90
1918.....	454	.90	16,497	36.3	59	13.00
1919-23.....	875	5.29	42,084	48.1	176	20.11
1919.....	371	1.24	16,525	44.5	100	26.95
1920.....	157	1.12	8,281	52.7	24	15.29
1921.....	123	.83	6,481	52.7	26	21.14
1922.....	118	.97	5,499	46.6	16	13.56
1923.....	106	.91	5,298	50.0	10	9.43

¹ Department of Radiology, Lahey Clinic, Boston, Mass.

It is true that following an injury to the spine the degree of trauma is not always in direct proportion to the resulting damage, pain, or disability. The purpose of this paper is to show why some patients are more affected than others, to give some of the diagnostic criteria, with special reference to roentgenologic interpretation, and to suggest some form of prophylaxis in selected cases.

ANATOMIC CONSIDERATIONS

The articulations of the vertebral column consist of a series of arthrodial joints between the vertebral bodies and a series of diarthrodial joints between the vertebral arches. Stress on these joints is neutralized or compensated by muscles and ligaments of sufficient strength and tone to meet the conditions without fatigue or strain. When the strain is too great or too prolonged, the muscles and ligaments become decompensated, and the condition must be relieved by rest or support. If still greater stress is applied to the spine either through direct violence or severe exertion, these muscles and ligaments may go beyond mere decompensation and definite damage may result. Add to this force certain anomalies of the spine, and the effect is still greater.

Haboush (1) has shown experimentally the effect of forced flexion on the lumbosacral joint. When the limits of flexion of the lumbar spine are reached, the strong supraspinal ligament and lumbar fascia act as a check and produce rotation and lateral deviation of the lumbar spine and cause tension to be transferred to the iliolumbar ligament, quadratus lumborum fascia, and the intertransverse ligament on the convex side of the lumbar spine. Continued forced flexion results in a tear or partial rupture of the anterior and posterior longitudinal ligaments, the articular capsule, the ligamentum flavum, and the interspinal ligament, and there is separation of the neural arch on the injured side with involvement of the annulus fibrosus, intervertebral disc, and nucleus pulposus.

The roentgenogram demonstrates a variety of anatomic, developmental, and pathologic conditions capable of predisposing to lumbosacral strain, which may or may not bear a relationship to the patient's symptoms. Whether symptoms actually are arising from the lumbosacral condition is a clinical and not a roentgenologic problem. If such a condition can be predetermined, it would be of vital importance to the service in selecting men physically fit for strenuous duty. It would also aid in determining disability as it existed prior to entry into the service and in judging disabilities which were aggravated by the service.

LUMBOSACRAL ANOMALIES

Lumbosacral anomalies produce symptoms only through abnormal stress or pressure. The stability of the lumbosacral region depends to a great degree on the symmetry of the articulating facets.

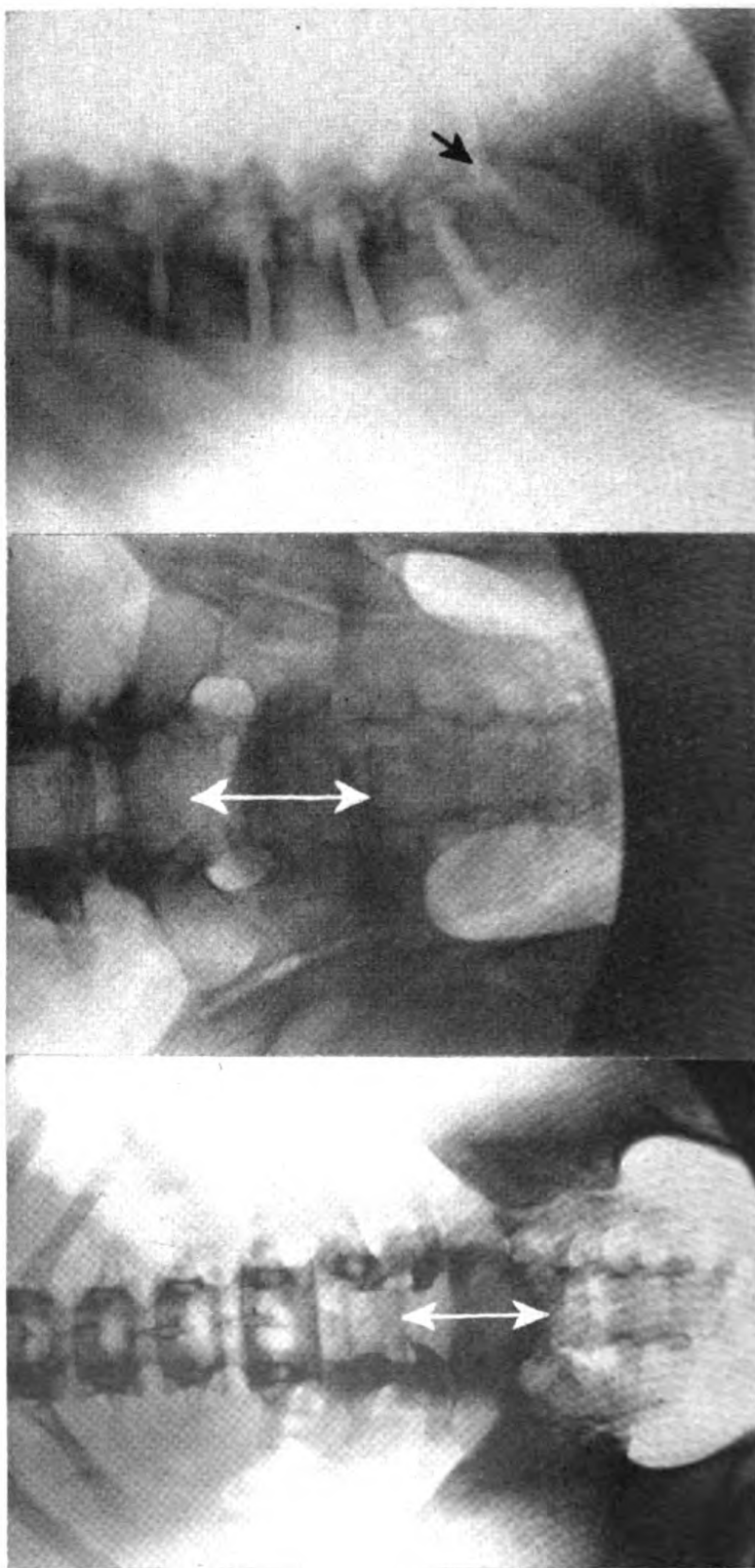
The most stable condition is present when the articulating facets are symmetrical, and face mediolaterally with the joint in the sagittal plane. Such joints show clearly in the anteroposterior roentgenogram; however there may be variations. The facets may incline laterally; they may be rudimentary, irregular, defective, or in various planes from the sagittal to the transverse (anteroposterior facets). In such cases oblique views frequently will give more information concerning the condition of the joint than the anteroposterior view.

Asymmetry may be noted in approximately one-fourth of all human spines (2). Asymmetry is severe when one facet faces mediolaterally and the other anteroposteriorly. With such a mechanism, every motion puts undue strain on one or the other of these facets, as they do not operate in the same plane. Pheasant and Swenson (2) showed statistically that the incidence of osteo-arthritis was least in bilateral, symmetrical, coronally placed articulations, and highest in the markedly asymmetrically placed articulations. They also noted that the degree of osteo-arthritis present in these cases was always more advanced than the roentgenogram indicated.

Subluxation of the articulating facets with the resulting arthritis about the joints is a frequent cause of low back pain. Scott (3) gives definite criteria for diagnosing apophyseal subluxation: (1) Narrowed intervertebral disc; (2) impingement with erosion and sclerosis of the inferior articulating facets on the lamina of the next lower vertebra with impingement of the superior articulating facets of the lower vertebra on the pedicle of the vertebra immediately above; and (3) overriding of the articulating surfaces of the opposing vertebra.

A transitional type of vertebra may be present at the lumbosacral junction. The transverse process on one or both sides may show enlargement, with pseudo-arthritis or complete fusion to the sacral wing. There is frequently a degenerative reaction around the pseudo-arthritis. Fusion on one side alone predisposes to unequal distribution of stress and motion and is often the cause of low back pain.

Congenital defects, such as spina bifida and spina bifida occulta, may be present (fig. 1). Such defects are significant because they may contribute to additional weakness, especially when other defects are present.



1. SERIAL ROENTGENOGRAMS OF THE LUMBOSACRAL SPINE SHOWING A SPINA BIFIDA OCCULTA OF THE FOURTH AND FIFTH LUMBAR VERTEBRAE AND THE ENTIRE SACRUM. NOTE THE ASSOCIATED SPONDYLOLISTHESIS.

Scoliosis is obvious in the roentgenogram. From the point of view of treatment, differentiation as to whether it is structural or postural is important. If there is a compensatory dorsal curve, it is postural and usually results from an unstable lumbosacral joint. Sciatica may or may not be present. Postural curve may be differentiated from structural curve with the patient lying and the body bent to the maximum to the right and then to the left. Postural curves allow nearly equal bending to the right and left in all portions of the spine, while structural curves reveal a definite limitation of bending in the direction of overcorrection of the curve in the affected portion of the spine (4).

Wedging or compression with or without fracture of one or more vertebrae may be noted. In these instances, weakness is present as a result of poor mechanics, and abnormal stress or strain is put on the muscles of the back. It is very important to determine the cause, which may be the result of local disease, infection, neoplasm, neurotrophism, or general decalcification as occurs in diseases of calcium deficiency. Roentgenograms are often characteristic in these cases.

In spondylolisthesis, which usually causes low back pain and sciatica, the fifth lumbar vertebra is most commonly involved. It is best seen in the true lateral roentgenogram (fig. 1). Differentiation from traumatic displacement of a vertebral body is important, as the former is frequently the result of a congenital defect in the posterior element of the spine, which permits the vertebra to ride forward. Spondylolisthesis being congenital or the result of congenital defects of the posterior elements, the predisposing feature may be considered as present prior to enlistment. Another differentiating point is overdevelopment of the first sacral body and broadening of its anteroposterior diameter. Such overdevelopment, when present, has been considered evidence that the condition is of long duration and not due to injury (4).

The arthritides as the cause of low back pain and sciatica cannot be overemphasized. They are usually the result of circulatory, mechanical, or toxic factors, and should be recognized as predisposing to disability.

In all these conditions, as the result of poor mechanics, stress is distributed unequally, and certain joints must bear an excess load. The result is trauma to the involved joint. A degenerative reaction is set up about the joint, characterized by eburnation of the bone, irregularity of the bone surface, and frequently spur formation. These changes are seen clearly in the roentgenogram. When the process becomes extensive and the mobility of the joint is restricted as the result of deformity, pressure may be placed on local nerves.

Certain types of arthritis, such as Marie-Strümpell, are slowly progressive, and occur primarily in young adults. When such a condition is diagnosed, it should be the basis for declaring a man unfit for military service. Since this condition is important enough to warrant a special report, a subsequent article will describe the clinical course and the roentgenologic findings.

INTERVERTEBRAL DISCS

In the military service, injuries of the intervertebral disc definitely are on the increase (5), and as Dandy (6) points out, this condition is the cause of a great percentage of hitherto incurable and untreatable causes of low back pain and sciatica. The cause usually is considered as traumatic or the result of exertion, particularly sudden forced flexion.

The result of forced flexion is known. If one adds to this some abnormality or anomaly of the lumbosacral spine, a ruptured or protruded intervertebral disc becomes probable.

The clinical aspects of ruptured intervertebral disc have been covered by Love (5), Dandy, (6) Eaton (7), and others. Love and Walsh (8) and Spurling and Grantham (9) found that 96 percent of all ruptured spinal discs were situated at the fourth and fifth lumbar interspaces; and if only lumbar discs were considered, over 98 percent were in these two situations. In view of these findings and emphasizing the clinical picture, some authors (6) (10) have suggested that no spinal injections were necessary to rule out or to locate the protruding disc. However visualization of the deformity by means of some contrast medium is convincing.

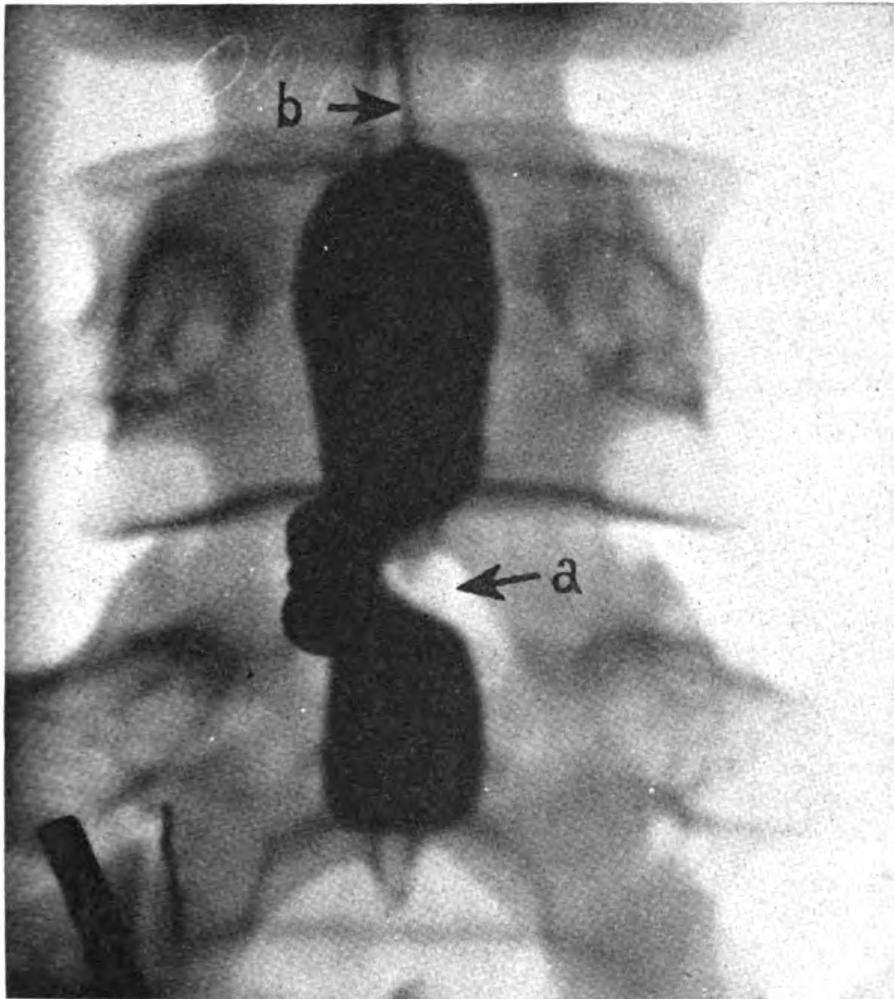
The contrast mediums that have been used are thorotrast (11), lipiodol and air or oxygen (12). Air may be used either epidurally (13) or intradurally. The ideal contrast medium has not yet been produced, but we believe that intradural injection of oxygen is the least hazardous and the most practical.

Although thorotrast and iodized oil give the best contrast, they have certain distinct disadvantages, and neither is without some danger. The thorotrast solution for myelography contains 25 percent by volume of thorium dioxide. After injection and roentgenologic examination, there follows a rather complex and difficult procedure of forced drainage to recover the solution. According to the method described by Bunts (11), about 70 to 90 percent is recovered. Since thorium dioxide is radioactive, the alpha and gamma radiations of the remaining solution may be toxic, particularly if the attempt at removal is incomplete.

Lipiodol may be used if the oxygen fails to demonstrate a suspected lesion, according to the method described by Kubik and Hampton

(14). They describe a method of withdrawing all the iodized oil by the lumbar puncture needle following the examination (fig. 2). The iodized oil may become dispersed, or for some other reason, removal may be incomplete, and an arachnoiditis may develop.

Epidurography with air, as described by Sanford and Doub (13), is not as easy or as accurate as the intradural injection. They report a



2. LIPIODOL MYELOGRAM. (A) PROTRUDED INTERVERTEBRAL DISC BETWEEN THE FOURTH AND FIFTH LUMBAR VERTEBRAE. (B) THE SPINAL NEEDLE IN THE MID-LINE, FOR WITHDRAWING THE LIPIODOL FOLLOWING THE EXAMINATION.

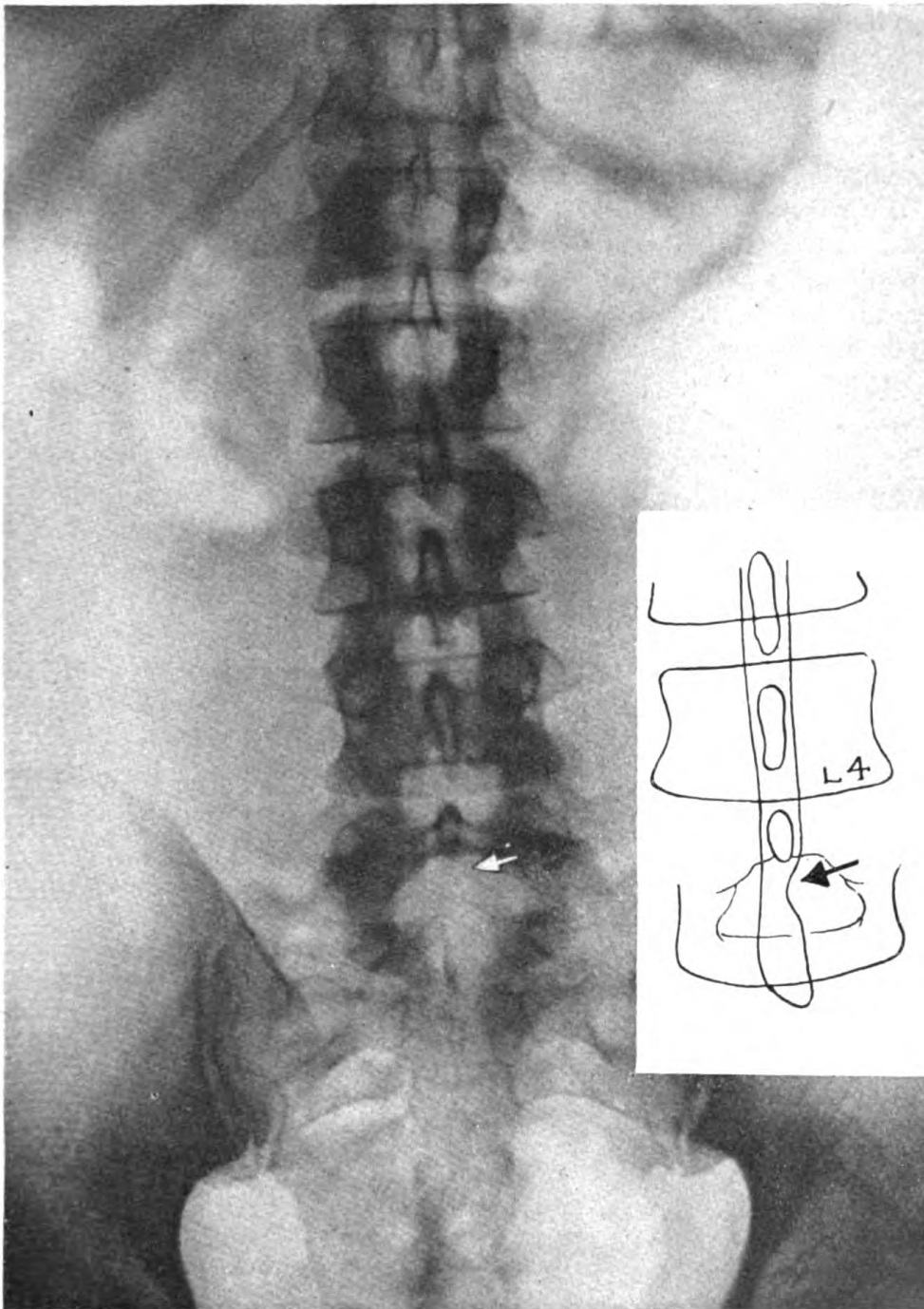
diagnostic accuracy of 55 percent; however they believe that there are fewer postoperative headaches following this procedure. Using oxygen instead of air, we believe that these headaches are reduced to a minimum because oxygen is more easily absorbed.

At the Lahey Clinic well over 500 oxygen myelograms have been performed, and for this study 100 consecutive cases at the New England Baptist Hospital were reviewed without access to the clinical

findings until the roentgenologic diagnosis had been made. Of the 100 cases reviewed, 70 patients came to operation and 60 of these were diagnosed correctly by roentgenogram alone. Ten patients were diagnosed incorrectly and 30 did not come to operation, giving a diagnostic accuracy of nearly 85 percent. Experience in interpreting the roentgenograms is most important, as our records show how wrong our diagnostic impressions were in the first cases. When a protruded intervertebral disc is present, oxygen myelograms usually show a defect in the air column at the level of the involved interspace (fig. 3). In the presence of scoliosis the interpretation is most difficult. The protrusion may not be present at the time of the examination or may be of such a nature (the so-called hidden disc) that it is not visualized in the roentgenogram.

In the procedure recommended, the patient is given nembutal, gr. 3, and pantopon, gr. $\frac{1}{3}$, 1 hour before the myelogram. He is placed in a lateral prone position on a tilting table. A 17-gage spinal needle is inserted into the third lumbar interspace under novocaine anesthesia. The third interspace is selected to eliminate the possibility of questionable shadows which may result should any extradural bleeding take place during the procedure. The dynamics of the spinal fluid is checked. Thirty-five cubic centimeters of spinal fluid are allowed to flow freely from the needle. The first 5 cc. are saved for a total protein determination. A total protein above 40 mg. percent is present in approximately two-thirds of the cases of intervertebral disc (5). When the desired amount of spinal fluid has been obtained, the table is tilted 15° with the head down. Fifty-five cubic centimeters of oxygen are rapidly injected through the spinal needle into the intradural space. Overdistention of the canal to insure filling of the nerve roots is necessary. It is particularly important that the needle remain stationary, because if it should be pushed through or pulled out of the dura, some filling of the extradural space and poor filling of the intradural space will result. It is also important to withdraw the needle rapidly while still attached to the syringe, and place the finger or pad immediately over the puncture wound, otherwise some of the oxygen will escape. Following the injection (one has 20 minutes in which to take roentgenograms before the oxygen disappears), the table is tilted immediately to 30° , with the head down and the patient is placed in position for the first roentgenogram. The following stereoscopic exposures are made, paying particular attention to true positioning: (1) True lateral, the side of the most pain uppermost; (2) anteroposterior; and (3) 45° view of the lumbosacral angle.

Normally the oxygen filled canal is smooth in outline, and usually the nerve roots are well defined. Protruded discs will show as a lo-



3. ANTEROPOSTERIOR MYELOGRAM WITH OXYGEN, IN WHICH A PROTRUDED DISC IS SEEN BETWEEN THE FOURTH AND FIFTH LUMBAR VERTEBRAE. THERE IS AN INDENTATION OF THE AIR COLUMN OPPOSITE THE PROTRUDED DISC.

calized indentation or narrowing of the canal, and the nerve root when seen may be displaced. Sometimes the nerve root will be incompletely filled or totally obscured. When the disc is bilateral and large, it may show a total blocking of the canal, simulating a cord tumor.

SUMMARY

Normally the muscles and ligaments of the lumbosacral spine are of sufficient strength and tone to meet conditions of stress and strain without fatigue. When the stress becomes too great, the muscles and ligaments become decompensated. A support such as a snugly fitting belt or corset supporting the lumbosacral region would be of distinct value in preventing undue strain and injury.

Anomalous and anatomic defects of the lumbosacral spine result in poor mechanics, weakness, early fatigue, and predispose to low back pain and sciatica. Obviously when selecting men for strenuous military service, those with such defects should be determined. In such instances, a routine roentgenologic examination of the lumbosacral region would be of distinct value.

A common cause of low back pain and sciatica is the protruding intervertebral disc. Such a condition produces a fairly typical clinical picture and is readily diagnosed by means of oxygen myelogram in a high percentage of cases.

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THE MORTALITY IN ACUTE APPENDICITIS¹

ITS REDUCTION BY DIAGNOSTIC AND THERAPEUTIC METHODS

HORACE R. BOONE

Captain (MC) U. S. N., retired

and

SHIRLEY C. LYONS

Lieutenant Commander (MC) U. S. N. R.

Reginald Fitz, who in 1886 wrote the first definitive treatise on acute appendicitis (1) was a pathologist and his conclusions were based on postmortem evidence, but no clinician has ever discussed the subject more practically. It is astonishing, therefore, to find that after more than 50 years have elapsed, a disease which is the most readily curable of all surgical states should continue to be attended with a high mortality while many other conditions far less amenable to cure have been almost completely conquered.

The continuing high mortality of acute appendicitis is readily explained. It rests, literally, upon a house-that-Jack-built foundation. Deaths occur in this disease because (a) surgery is delayed and (b) purgation is instituted. But these practices are predicated upon (c) delay in diagnosis, which in turn is due to the fact (d) that a large number of physicians have no real concept of the progressive pathology of acute appendicitis and of the variability of its symptom-complex. A further reason, recently discussed by Reginald Fitz's own son (2), might also be mentioned: It is significant that the elder Fitz's paper was read before the American College of *Physicians*, and distressing that the same policy has not been continued over the years. The therapy of acute appendicitis is exclusively surgical, but the diagnosis is most often made by the *physician*, who sees the patient first, and it is upon his course of action far more than upon the surgeon's technical ability or even upon his judgment that the outcome of the case depends.

It is general knowledge, even among the laity, that the typical patient with acute appendicitis presents a certain triad of symptoms, namely, abdominal pain, nausea with or without vomiting, and fever, and every physician knows that the typical patient with this disease also presents a certain triad of signs, namely, abdominal tenderness, rigidity, and leukocytosis. But most lay persons do not know, and many physicians fail to remember, that this double triad does

¹ Received for publication March 12, 1943.

not occur in every case and is, in fact, absent in anywhere from 25 to 40 percent of all patients suffering from the disease. As a result of this forgetfulness another classical triad, namely, purgation, procrastination, and perforation, is frequently observed in the group of cases in which the deaths from acute appendicitis are chiefly concentrated.

So far as the medical profession is responsible for the mortality, deaths from acute appendicitis could be almost entirely eliminated if certain general principles of diagnosis were borne in mind. The first of these principles has to do with the incidence of the disease. Acute appendicitis is the most frequent of all acute surgical states, and by the law of averages, if for no other reason, it is the condition most likely to be present in any patient with abdominal pain whose appendix has not already been removed. It can occur at any age, although it is most frequent in adolescents and young adults, and it can occur in coincidence with any other disease or condition. It might be added that although it is most infrequent at the extremes of life, it is potentially most serious in these age groups.

The second principle of diagnosis is the realization that the recognition of acute appendicitis is accomplished by strictly clinical methods, that is, by an accurate, painstaking history, a careful physical examination, and observation of the patient at frequent intervals, or preferably continuously, in any case in which the diagnosis cannot be made at the first examination. This is a disease in which the laboratory furnished little if any assistance.

The third principle of diagnosis is based upon the urgency of acute appendicitis. The progressive pathology of the disease does not permit hairsplitting diagnostic considerations. This statement should not be construed as an invitation to reckless surgery but merely as a definite warning that whenever acute appendicitis cannot be positively excluded, the patient's best interests, provided contraindications to surgery do not exist, demand immediate exploratory laparotomy.

THE CLINICAL PICTURE

Pain.—"Always" and "never" are words which should be sedulously avoided in a discussion of medical matters, but if generalizations are ever warranted, they would be justified in the discussion of pain in acute appendicitis. It is the most constant and most important of all symptoms. If pain is not present, the physician who hesitates to make the diagnosis has reason on his side, though events occasionally prove him to have been mistaken. On the other hand, the physician who does not seriously consider at least the possibility of acute appendicitis when he is confronted with a patient

with abdominal pain and an appendix still in situ, is likely to have more than one death on his conscience before he learns his lesson.

Generally speaking, pain is usually the first symptom of acute appendicitis, though neither John B. Murphy (3) nor Lord Moynihan (4) were correct in their generalization that "if it be not the first symptom, the disease is not appendicitis." Generalizations as to the origin of the pain are also not warranted, except for the statement that it does not usually originate in the region of the appendix. Most often it is first noted in the epigastrium or about the umbilicus, but it may originate on the left side or in the pelvis, or, occasionally, in both lower quadrants. It may be continuous, like old-fashioned stomach-ache, or spasmodic, like green-apple colic. It may radiate to the right thigh and leg, to the rectum, to the testicle, or even to the right shoulder. Colicky pain is characteristic of obstructive appendicitis, first described by Van Zwahlenburg (5) and Wilkie (6) and more recently placed upon a firm pathologic basis by the experimental and clinical studies of Wangenstein and his associates (7). In this type of disease immediate surgery is particularly imperative because of the risk of early perforation.

Wherever the pain of acute appendicitis may originate, in the majority of cases it localizes in the right lower quadrant of the abdomen within a period varying from 1 to 48 hours but most often within 4 to 24 hours after the onset. Localization, however, is often not definite and sometimes, especially in very young children and in persons advanced in years, it may not occur at all.

The subsidence of pain is often looked upon as a desirable event, and often it does indicate either that the disease is progressing toward resolution or that the contents of the obstructed organ have emptied into the cecum. At other times, however, it indicates the onset of gangrene, or, especially if subsidence has been abrupt, the occurrence of rupture. Many writers have emphasized that the disappearance of pain should never be interpreted as a hopeful omen unless all other symptoms are also improving.

Nausea and vomiting.—Nausea, which may or may not be followed by vomiting, is the second most important and most frequent symptom of acute appendicitis, though it is by no means as constant as pain. Careful inquiry frequently reveals that a period of anorexia or vague digestive distress has preceded the pain, particularly in older persons. Nausea usually occurs promptly. Vomiting is more likely to occur 3 or 4 hours after the onset, though it may also occur 24 or 48 hours afterward, or even later. It is likely to be present promptly if food or fluid has been taken shortly before the onset of the pain. It may occur once or several times, but if it is continuous, extension of the disease beyond the appendix should be suspected. Like pain,

vomiting occurs more readily in some patients than in others, particularly those of nervous temperament or prone to digestive upsets. If the illness has been preceded by a dietary indiscretion, as is not unusual, the diagnosis may be very difficult and the mortality in this group of cases is likely to be high.

Vital signs.—Some elevation of temperature can be expected, as in all inflammatory conditions, within 3 to 24 hours after the onset in any case of acute appendicitis not progressing toward resolution or interrupted by operation. Fever is ultimately present even in the obstructive type of disease because infection is ultimately introduced. It may be of any level, though if the initial temperature is high, the diagnosis of acute appendicitis is less likely, while if the disease should prove to be appendicitis, the prognosis, in the opinion of some observers, is poor. The temperature is likely to be higher in young children than in adults, and to be lower in aged subjects because of their sluggish reaction to inflammatory processes. The pulse rate is usually between 90 and 100 per minute, but all ranges are possible. Nervous, excitable subjects usually present higher rates than phlegmatic subjects.

Physical findings.—The most constant physical finding in acute appendicitis is localized tenderness, which is an objective phenomenon elicited by the physician and to be distinguished from pain, which is a subjective phenomenon experienced by the patient, as well as with the physician's method of approach. The suspected area should always be investigated after the remainder of the abdomen has been palpated, and the examination, especially in nervous subjects and young children, will defeat its own purpose if it is not carried out very gently.

Tenderness to digital pressure can often be elicited in the right lower quadrant of the abdomen soon after the onset of the illness and even before pain has localized in this area. Later it is usually possible to find a single point of maximum tenderness, for which a dozen locations have been suggested, the most familiar being those described by McBurney, Lanz, Gray, and Clado. Local tenderness and muscle spasm over the oblique muscles, lateral to McBurney's point and just above the anterior superior spine of the ilium, are highly suggestive of retrocecal appendicitis.

Rebound tenderness (Blumberg's sign), while indicative of an acute inflammatory process within the abdomen, does not necessarily indicate acute appendicitis. Sloan's maneuver, the Rovsing-Owen test, and similar eponymic tests are all of value in special cases but have no universal application. Local hyperalgesia is helpful when present.

Rectal examination should not be omitted in any case, though it is of greatest value in young children, in whom the appendix is readily

accessible to the examining finger, and when the organ is in the pelvis. Rectal tenderness is usually confined to the right side when the disease is limited to the appendix.

Muscular rigidity is a reflex protective mechanism which is frequently but by no means constantly associated with localized tenderness. It may affect the entire abdominal wall or be limited to the recti muscles. Early in the disease it amounts to little more than a sense of resistance and often is demonstrable only by comparison with the unaffected side. After a certain period, as Cope (8) first pointed out, rigidity disappears partly as a toxic phenomenon and partly as the result of fatigue of the neuromuscular reflex. Rigidity may be absent in older persons, whose reactions are often sluggish even when extensive peritonitis is present, but it is usually observed in children, whose nervous systems react readily to stimuli.

A distinction must be made between voluntary rigidity, which is initiated by the patient, and involuntary rigidity, which is the result of the pathologic process. The former can usually be made to disappear by continued gentle pressure or by stroking the area while the patient's attention is distracted, but the latter variety is only increased by such manipulations.

Clinical laboratory studies.—The laboratory, as already pointed out, is not of great assistance in the diagnosis of acute appendicitis. Urinalysis should be carried out routinely but is of diagnostic aid only when the question of urinary tract disease has been raised. A total and differential blood count should also be routine, though there is rather general faith in the dictum attributed to A. J. Ochsenr, that the physician, while he should always carry out the test, would do well not to look at the results until after he had removed the appendix (9). The Schilling hemogram, in the opinion of some observers, has increased the diagnostic value of blood studies, but others believe that the method is not worth the additional time which it takes.

McKenna (10) has recently called attention to an observation made in the last war, that the leukocytic count in acute appendicitis tends to be low after typhoid vaccination, and the warning is of value in view of the present mass vaccination of the armed forces.

DIAGNOSTIC CONSIDERATIONS

To reduce the foregoing facts to crude percentages, it may be said that abdominal pain is present in 98 percent or more of all cases of acute appendicitis, nausea in 70 to 80 percent, and vomiting in 50 to 70 percent. From the standpoint of physical signs, tenderness is present in 95 percent or more of all cases, and rigidity in 80 percent. The significance of these proportions is that, contrary to a

rather general belief, none of them reaches 100 percent and some of them are as low as 50 percent. In other words, although the classical triad of symptoms and signs is present in the majority of cases of acute appendicitis, one or more is lacking in a large proportion of cases, or the sequence of events is atypical, or there is some other departure from the textbook picture of the disease. In such a case, as has already been pointed out, if the diagnosis of acute appendicitis cannot be positively excluded and a reasonable suspicion of the disease exists, then exploratory operation is justified, and such procedure remains justified even if the appendix is found to be normal or only slightly inflamed when the abdomen is opened.

The variability of the position of the appendix and the resultant confusion in the clinical picture are very well known, but attempts to correlate the symptomatology and physical findings in acute appendicitis with the position of the appendix are not without risk. A review of the literature reveals the interesting fact that there is frequently total disagreement between equally experienced observers who have made the attempt, and the disagreement is easy to understand if the physician will remember, for instance, the number of times he has himself diagnosed a ruptured appendix with abscess formation, only to find, at operation, that the mass consisted of an unruptured appendix wrapped in omentum.

THERAPY

The treatment of acute appendicitis is exclusively surgical, and, generally speaking, immediately surgical. Sometimes the patient with advanced disease is too ill for immediate surgery, but in the opinion of most observers, which we share, operation should be delayed only until he is sufficiently rehabilitated to permit the necessary manipulations. The occasional surgeon is still in favor of so-called expectant treatment in perforated cases, but the pendulum is more and more swinging to the entirely rational concept that if the mere act of operation is not lethal, it is not logical to permit a ruptured appendix to continue to pour its toxic and infected secretions into the peritoneal cavity.

As we have already pointed out, a lowered mortality in acute appendicitis depends, above everything else, on the promptness with which the diagnosis is made and operation is performed. There is no doubt, however, that the continued use of the same routine of anesthesia and surgical technic does play a part in lowering the mortality in individual hospitals. Furthermore, some established routine is obviously necessary for the treatment of a disease which may occur under any circumstances and which, due to the exigencies of warfare, must often

be treated under conditions which are anything but ideal. For that reason we recommend the following method of treatment, which is as simple as can be devised and which we have found highly satisfactory.

Anesthesia.—Spinal analgesia is the method of choice for all good-risk cases, though the contraindications to its use must be strictly observed. These include: Advanced pulmonary disease, cardiac disease, pernicious anemia, and other systemic conditions; abdominal distention of a degree sufficient to cause splinting of the diaphragm; and tuberculosis of the spine or any other disease or anomaly localized in the spinal cord, including skin lesions in the region in which the puncture must be made. Spinal analgesia is never used if the patient has a history of neurologic sequelae or other abnormal symptoms following previous spinal puncture or spinal analgesia.

Administration of oxygen during the operative procedure by means of a Boothby-Lovelace mask makes for easier breathing and reduces the incidence of nausea.

Technic—The McBurney incision is used in all cases in which the diagnosis of acute appendicitis can be definitely established before operation. We personally regard its use, as do many other surgeons, as an important factor in lowering the mortality, especially in complicated cases.

It is our custom to remove the appendix, even if an abscess has formed, whenever the procedure does not involve too great trauma. Our technic is very simple. The base of the appendix is clamped and is doubly ligated, chromic No. 1 catgut being used for the ligature proximal to the cecum and plain No. 0 catgut for the second ligature, which is placed immediately above the first. A second clamp is applied close to the upper ligature, and the appendix is amputated immediately below it. The stump is touched with phenol, followed by two applications of alcohol, and is dropped back into the cavity without further treatment. We prefer this method to either ligation and inversion of the stump or inversion without ligation, being unable to share the fear of simple ligation expressed by some authors (11) or their enthusiasm for inversion without ligation. Great care is taken throughout the procedure that the appendix does not touch the uncontaminated abdominal wall.

Drainage is seldom practiced except in the presence of extensive abscess formation or when bleeding has been free and hemostasis is questionable.

Chemotherapy.—For many months it has been our custom, in all cases of generalized and local contamination of the peritoneal cavity, as well as in cases of extensive appendiceal involvement in the absence of rupture, to deposit sulfanilamide in the cavity before the abdomen is closed. A small amount is also placed in the layers of

the abdominal wound. We formerly used from 6 to 8 gm. of the drug, but have found that equally good results can usually be secured when the total dosage does not exceed 4 gm. Sulfanilamide is the drug of choice. The absorption of sulfathiazole is slower, and both sulfapyridine and sulfadiazine act as peritoneal irritants (12).

Jackson and Collier (13) and Mueller and Thompson (14) have pointed out that when sulfanilamide is used by intraperitoneal implantation, the rise in the blood level is prompt and abrupt, in contrast to the slower rise and more gradual fall when oral and subcutaneous routes are used. Mueller and Thompson do not consider supplemental parenteral administration of the drug necessary when the intraperitoneal method is used, and Jackson and Collier warn that if additional chemotherapy is considered necessary, it should be deferred for 18 hours or longer. Our own plan, if convalescence is unsatisfactory and the blood level of sulfanilamide is too low, is to administer daily 1,000 cc. of an 0.8 percent solution, which is given by hypodermoclysis in 250 cc. doses at 6-hour intervals.

There is no doubt in our own minds that the intraperitoneal use of sulfanilamide offers a method of direct attack on appendiceal peritonitis and has greatly reduced the mortality rate. Our results are in accordance with the observations of Ravdin and his associates (15), that intraperitoneal chemotherapy is most effective when there is a spreading invasion of the cavity and least effective in abscess formation, in which the wall forms a barrier against blood-borne drugs. Chemotherapy has also materially reduced the incidence of wound infections on our service and has prevented the extension of the contamination into the muscle layers, which is sometimes a serious obstacle to recovery. We have not observed the increase in serous exudate of which some observers have complained, and the use of this measure has permitted primary closure in many cases in which drainage would formerly have been necessary. On the other hand, whatever the bacteriostatic properties of the sulfa drugs may be, they do not entirely solve the problem of appendiceal peritonitis. Prompt diagnosis, prompt operation, careful preoperative preparation, exacting surgical technic, and the proper postoperative care are still as important as they ever were in the pre-sulfanilamide era.

Postoperative care.—A patient whose appendix has been removed before rupture seldom requires anything beyond routine postoperative care. In the complicated case morphine in liberal doses, constant intestinal decompression, parenteral fluid therapy (3,000 to 4,000 cc. every 24 hours), and plasma and whole blood transfusions as indicated comprise the necessary regimen. A minor point, but one which adds

considerably to the smoothness of the convalescence, is early attention to bladder function. If the patient is instructed to urinate within 4 hours after operation, the attempt is usually successful, and catheterization for a period of days is frequently thus avoided.

THE MORTALITY OF ACUTE APPENDICITIS

The mortalities for several large series of cases reported in the literature during the last decade vary from 1.9 percent reported by Jennings and his associates (16) to 8.2 percent reported by Holder and Wells (17). At the Charity Hospital of Louisiana at New Orleans, with which one of us (S. C. L.) was formerly associated, Boyce (18) has reported that the mortality in 5,208 cases over a recent 11¼-year period was 5.41 percent. This mortality approximates the average, and the difference between it and the far lower mortality reported by Jennings and his associates is easily explained: In the latter series 57 percent of the patients were seen within 24 hours of the onset of the illness, against 44 percent in the Charity Hospital series, in which, moreover, 25 percent of the patients were Negroes, who furnished 40 percent of the mortality. In the series reported by Holder and Wells only 12 percent of the patients were seen within 18 hours of the onset of symptoms.

An analysis of the United States Navy statistics for the 11-year period ending in 1940 showed 12,762 operative cases and 91 deaths, 0.72 percent.² Since 1937, furthermore, the mortality of the disease has shown a steady decline. This remarkably good record was recently explained (19) on the following basis:

1. Treatment is readily available for all Navy personnel.
2. All Navy personnel, including the medical staff, is carefully instructed in the possibility that any abdominal pain may prove to be acute appendicitis and is warned of the risk of purgatives, which are administered only on the order of a physician.
3. The number of interval and prophylactic appendectomies is constantly reducing the number of possible acute cases.

TABLE 1.—*The mortality of acute appendicitis in the United States Navy during World War I*

Year	Number of operations	Number of deaths	Average strength of navy
1917.....	1,088	8	245,580
1918.....	1,328	44	503,792
1919.....	1,465	24	298,774

² Actually, the operative mortality is slightly lower than the percentage stated, since several nonsurgical deaths are included in the 91 fatalities.

During the period of World War I (table 1) the mortality of acute appendicitis was very low in 1917, considerably higher in 1919, and very high, at least relatively, in 1918. In an endeavor to explain the latter circumstances we have analyzed the deaths in this special year, without, however, throwing any great light upon the matter except for the expected finding that all the cases were far advanced. Four of the 42 deaths were unexpected and must be attributed to an unfortunate concentration of the accidents which are likely to occur whenever a large number of operations are performed.

Excluding the two nonsurgical deaths, in which the diagnosis was not made antemortem, and the four deaths due to unanticipated surgical accidents, the remainder of the fatalities were clearly due to the advanced stage of the disease, which, the records suggest, was usually not the responsibility of the medical personnel. Undoubtedly the exigencies of active warfare played an important part, and the current epidemic of influenza, as has already been suggested, probably also played a part. Many of these patients, if they had developed their disease today, could have been saved by the use of sulfa drugs and by the present routine of postoperative care, including constant intestinal decompression, parenteral fluid therapy, and plasma and whole blood transfusions. In the last analysis, however, the great majority of the deaths occurred for the same reason that deaths are still occurring today—the patients were seen too late to be saved.

SUMMARY AND CONCLUSIONS

1. Acute appendicitis is still attended with an unreasonably high mortality, chiefly due to delays in diagnosis and treatment and to the institution of purgation, which themselves can be attributed to failure to comprehend the variable symptom complex of the disease.

2. The principles of diagnosis of acute appendicitis include a recollection of its frequency, a realization that diagnosis is a clinical and not a laboratory matter, and a comprehension of the urgency of the disease.

3. The clinical picture of acute appendicitis is discussed, with special reference to the variability of the syndrome.

4. The treatment of acute appendicitis is exclusively surgical. A routine of therapy which has proved satisfactory is briefly outlined.

5. The mortality of acute appendicitis in the United States Navy is analyzed, with particular reference to the unusually high mortality in 1918.

6. In the last decade the mortality of acute appendicitis in the Navy has been kept at a very low level, chiefly because the personnel is instructed as to its dangers, and prompt diagnosis and operation

are practiced. If the general population could be brought to realize the importance of these considerations, the general mortality of acute appendicitis would soon approximate the admirable level to which it has been reduced in the Navy.

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PILONIDAL CYSTS AND SINUSES IN THE NAVY¹

WARREN Z. LANE

Lieutenant, junior grade (MC) U. S. N.

The problem of pilonidal cysts and their treatment is of increased importance at this time because of the necessity of maintaining military personnel at maximum efficiency. In naval morbidity statistics pilonidal cyst was responsible for 36,136 sick days and rivaled acute appendicitis. Hernia (inguinal, direct and indirect) was accountable for 26,777 sick days, and syphilis for 28,783 during the statistical period of 1940 (1). During this period 450 new admissions and 54 remaining cases were treated for both quiescent and inflamed pilonidal cysts with a sick-days total of 28,106. Of this total, 16,777 days were tabulated for inflamed cysts and 11,329 for the quiescent type. The recorded total number of new admissions was 61,100 for all causes in 1939, and this makes an incidence of approximately 1:135 for the Navy. For comparison, out of 313,285 admissions over a 14-year period in a large civilian hospital, the diagnosis of "pilonidal sinus" was made 350 times (2). This is an incidence of approximately 1:940. The National Naval Medical Center, Bethesda, Md., reports an incidence of 1:120. The Army, for the year 1939, has an incidence of 1:295 (3). (See table 1 for a more complete demonstration of these figures.) An average of 40 sick days per case has remained constant for the 10-year period 1930-40 (1), in spite of the more general use of sulfonamide drugs and the new advances in surgical technics.

TABLE 1.—*Incidence of pilonidal cysts*

Year	Average strength Navy	Total new admissions all causes	New admissions pilonidal cysts	Sick days	Sick days per case
1938	139, 216	54, 810	424	24, 205	41. 7
1939	149, 618	61, 100	450	28, 106	42. 0
1940	202, 614	99, 886	529	30, 410	38. 1

The 50 cases forming the basis of this paper were selected from the files of the surgical service at the National Naval Medical Center, Bethesda, Md. The cases are consecutive and represent a variety

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of treatment technics and types of lesions. For the most part (72 percent) primary closure was the dominant procedure following excision of the cyst. A complete analysis was made of each case which included details of race, age, symptoms and signs, previous operations, pathology found, etc. Follow-up reports were not available. The recent literature was reviewed.

The main objectives of this study were: First, to show the results obtained from primary closure; second, to determine the influence of sulfonamide therapy in the healing time; and third, to determine if the period for rehabilitation is such as to warrant the enlistment of recruits who have a pilonidal cyst.

GENERAL CONSIDERATIONS

The problem of pilonidal cyst has been clarified by the recent article of Kooistra (2). In the Navy apparently the most recent study was done by Wharton (4) in 1932, who modified the Lahey flap closure. Promising results were obtained by this method of primary closure, but some were complicated by postoperative infection.

Several names have been suggested for these lesions, but Hodges (5) was the first to use the term "pilonidal" (pilus—hair; nidus—nest). Other names are sacrococcygeal ectodermal sinus, dermoid cyst and sinus, etc., but common usage favors the term pilonidal cyst. In the Navy Diagnostic Nomenclature it is referred to under "tumor" as "cyst, teratoma, inflamed or quiescent." (For studies of the embryology see Kooistra and Fox.)

Although the clinical features of pilonidal cyst have been thoroughly established in the past century, they are still missed with great frequency in the physical examination of recruits. The average age of the patients in this study was 24 years, with extremes of 17 and 43 years. The average duration of symptoms before admission was 2 years. The incidence is greatest, therefore, in the age group from whence comes the maximum number of recruits. It is significant to note here that all cases came from the Caucasian race. Only three cases give a definite history of trauma prior to the onset of symptoms and only one of this group could place the onset within 2 months of the traumatic incident.

It is said that there is a 3 to 1 predominance of males over females (6), and that females develop symptoms earlier in life than males. This may become of importance with the advent of WAVES in the naval service. Kooistra says:

While 40 percent of the females were under twenty years of age, only 19 percent of the males were in this age group. This fact, not previously re-

ported, apparently has an etiological significance. Since the human female reaches puberty earlier in life than does the male, it appears that these lesions are stirred on to activity by the sex hormones. The role these hormones play in regulating body growth in general and, particularly, growth in body hair and secondary skin structures is well recognized.

In this respect one might speculate regarding the clinical onset. Many cases are seen in which acute bacterial infection apparently does not play a role. Pathologically, hair and sebaceous material are found and many times evidence of marked chronic inflammation with foreign body giant cells. Such a tissue reaction is also seen in cases of acne vulgaris when the comedones have been sectioned (7).

In discussing the etiology of acne vulgaris, Andrews (8) notes that "changes in the consistency of the sebaceous secretion" is most frequent between the ages of 12 and 30, but usually is worse at puberty and adolescence. Thus, it is possible for such changes to occur, augmented by gonadal secretions, and when a stage is reached where liquefaction of sebum occurs the pilonidal cyst "leaks." This is the discharge complained of by the patient. With the loss of the sebaceous plug, organisms from the skin and colon invade the sinus area and an acute infection with abscess formation often results. In the patients without infection, the inflammation of the tissues around the cyst, due to the changed sebaceous material acting as a foreign body, is sufficient to produce the symptoms of "pain and discharge" (2) (4) (9). This discharge is irritating and may cause a severe pruritus, leading the unwary to a diagnosis of pruritus ani (10).

In this series of patients no attempt was made to study incidental or associated diseases. There was no patient with a family history of pilonidal cyst. Occupation in the Navy could in no way be correlated with the clinical onset.

TABLE 2.—Duration of symptoms prior to admission

Duration of symptoms	Number of cases	Duration of symptoms	Number of cases
1. Within 1 week.....	13	7. 2 to 4 years.....	7
2. 2 weeks to 1 month.....	6	8. 5 through 8 years.....	4
3. 1 to 3 months.....	4	9. 8 through 12 years.....	0
4. 3 to 6 months.....	3	10. Over 14 years.....	1
5. 6 months to 1 year, incl.....	7		
6. 1 to 2 years.....	5	Total.....	50

2 years=average from onset to admission.

CLINICAL MANIFESTATIONS

Symptoms.—In this series of 50 cases the average duration of symptoms from onset to admission was 2 years (table 2). The outstanding symptom was pain, present in 70 percent of the cases (table 3). In 10 cases admitted within 1 week of onset this was quite

marked. Usually the patient complained of sitting pain, or intermittent pain with periods of exacerbations and remissions. It is said that some female patients have an exacerbation at the time of the menstrual flow (2).

TABLE 3.—*Symptoms*

Symptoms	Number of cases	Percent of total	Symptoms	Number of cases	Percent of total
1. Tumor and pain.....	8	16	7. Tumor only.....	1	2
2. Tumor, pain, and discharge.....	6	12	8. Itch only.....	2	4
3. Pain only.....	10	20	9. Symptomless.....	1	2
4. Pain and discharge.....	8	16	Total.....	50	100
5. Discharge only.....	11	22			
6. Chills, fever, painful mass.....	3	6			

Total 35 with pain=70 percent.

Total 25 with discharge=50 percent.

The next most frequent symptom was discharge, present in 50 percent of this series. Irritation and itching frequently accompanied the discharge, which varied from a bloody pus which stained the underwear, to a thick, oily, foul-smelling secretion. Twenty of the patients told of recurrent sore spots over the "tail bone" and increased discharge at such times. Only six cases gave histories of previous operation. In four excision and primary closure was done and this admission represented the first recurrence. One case told of having the "hair pulled out" 10 years before, and the remaining case was excised followed by pack.

TABLE 4.—*Signs*

Signs	Number of cases	Percent of total	Signs	Number of cases	Percent of total
1. Abscess and sinus(es).....	5	10	6. Swelling only.....	0	0
2. Dimpling only.....	0	0	7. Inflammation and tenderness.....	15	30
3. Dry sinus(es).....	7	14	8. Scarring only.....	5	10
4. Sinus, discharge and hair.....	1	2	Total.....	60	-----
5. Discharging sinus(es).....	27	54			

Total with combined signs=10=20%.

Total cases=50.

(Where combined signs were found the figures are repeated.)

Total with sinuses=40=80%.

Findings.—The two most prominent findings were: First, a sinus in the sacrococcygeal region in 80 percent; and, second, inflammation and tenderness in 30 percent (table 4). Only 5 patients had abscesses and these were in the group that were admitted within a week of onset. In 24 cases the sinuses were discharging or material could be expressed on gentle pressure. The "dimpling" described in the textbooks was not seen in this series. Hair was rarely seen to grow from the sinus. In 3 cases the sinus extended to the left but-

tock and in one extension was directed to the bony surface. Two cases had sinuses that extended to the right buttock, one of which required an extensive plastic procedure. As a rule, the sinuses were solitary, in the midline, and about 2 to 3 centimeters from the anus, directly below the sacrococcygeal joint. In 5 patients no sinus was noted, a true pilonidal cyst.

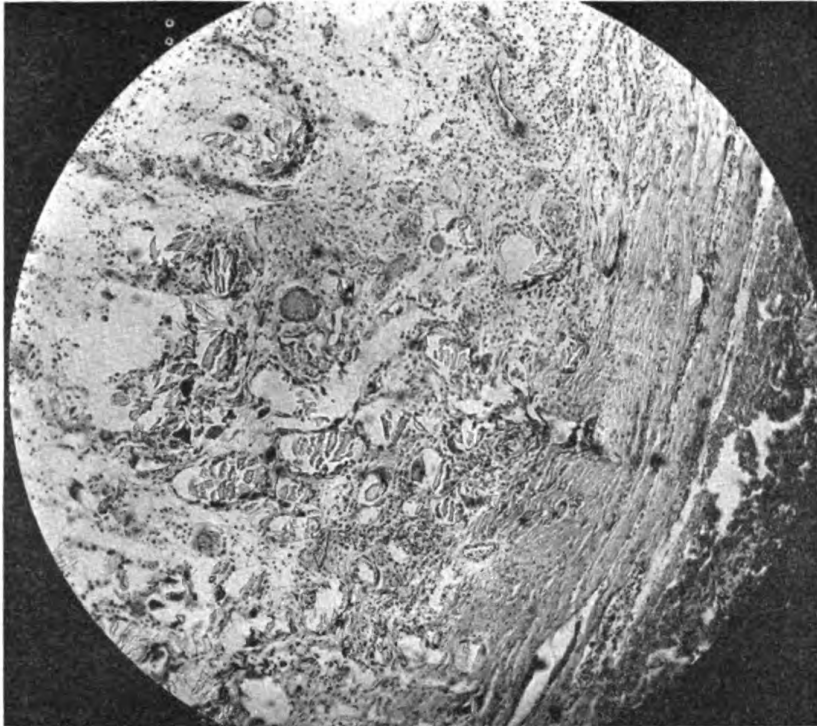
In the literature, 14 cases have been reported in which the sinus communicates with the spinal canal (11). Meningitis and subdural abscess have resulted in such cases when the cyst became infected. Usually in these cases the sinus is at a higher level than the sacrococcygeal joint, raising some question as to whether a diagnosis of pilonidal cyst was justified.

Laboratory procedures.—Only the routine Kahn test, the complete blood count and urinalysis was done preoperatively. In two cases bacteriological examination revealed no growth and *Staphylococcus albus*, respectively. No attempt was made to inject opaque substances for roentgen examination. The specimens were sectioned in a routine manner by the pathologist, and no attempt was made to do serial sections.

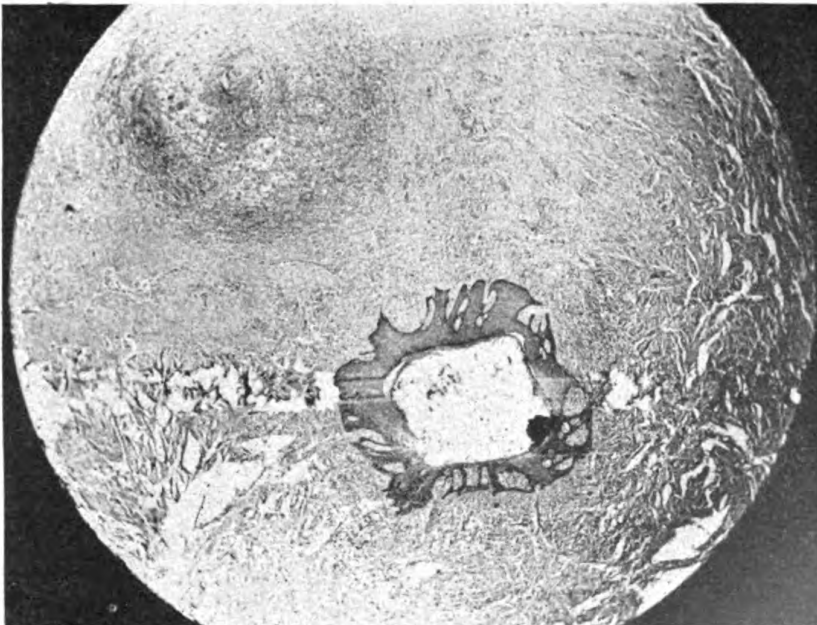
PATHOLOGY

Forty-two specimens were examined representing 41 patients. The pathologist's report was supplemented by an independent study by the author. The usual gross picture was that of a sinus tract leading to a small, cystic structure (under 3 centimeters in diameter) filled with pus, debris, and degenerating lanugo hair (fig. 1). In six cases there were communicating ramifications, running laterally into the buttocks for a distance of about 10 centimeters. One case penetrated to the periosteum of the sacrococcygeal region.

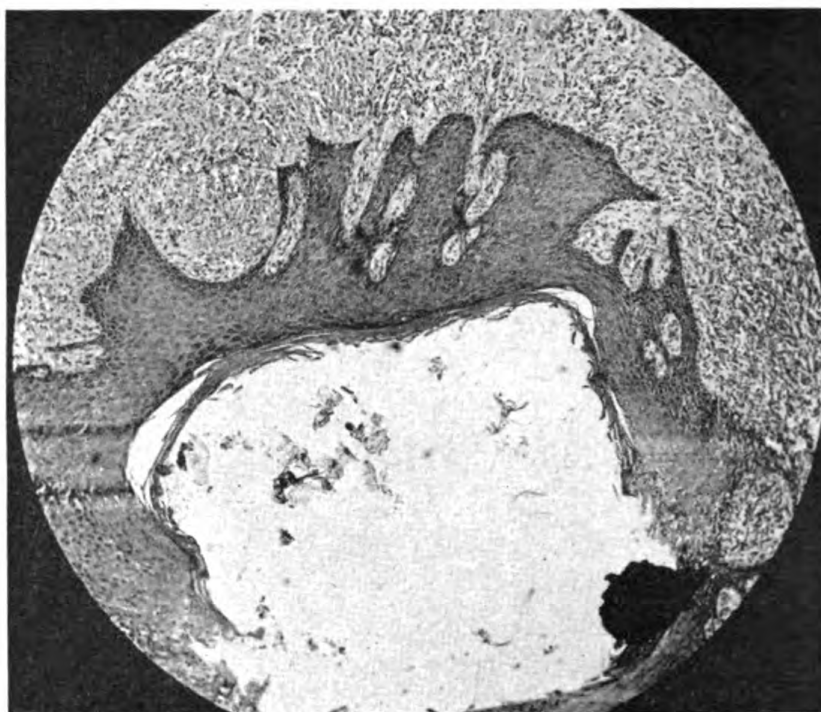
On microscopic examination, stratified squamous epithelium lined the cyst and sinus tract in 3 cases (figs. 2 and 3). In 26 percent there were variable amounts present, but ulcerated and present only in fragments. In the majority, 59 percent, the skin structures were completely destroyed, leaving a chronically infected sinus tract lined with a vascular or dense fibrous connective tissue. Inflammation was noted in all cases. Polymorphonuclear leukocytes, lymphocytes and plasma cells, as well as large mononuclear cells, were present. Only four cases showed a definite acute inflammatory response with coagulation necrosis and infiltration of the surrounding fibrous tissue by pus cells. Hair was seen in 26 cases (61 percent); of these 14 (33 percent) had definite follicular structure. Usually the hair was detached, very fine, and surrounded by foreign body giant cells (fig. 1). These giant cells were seen in 40 percent of the sections, and were embedded in vascular granulation tissue. Serial sections were not



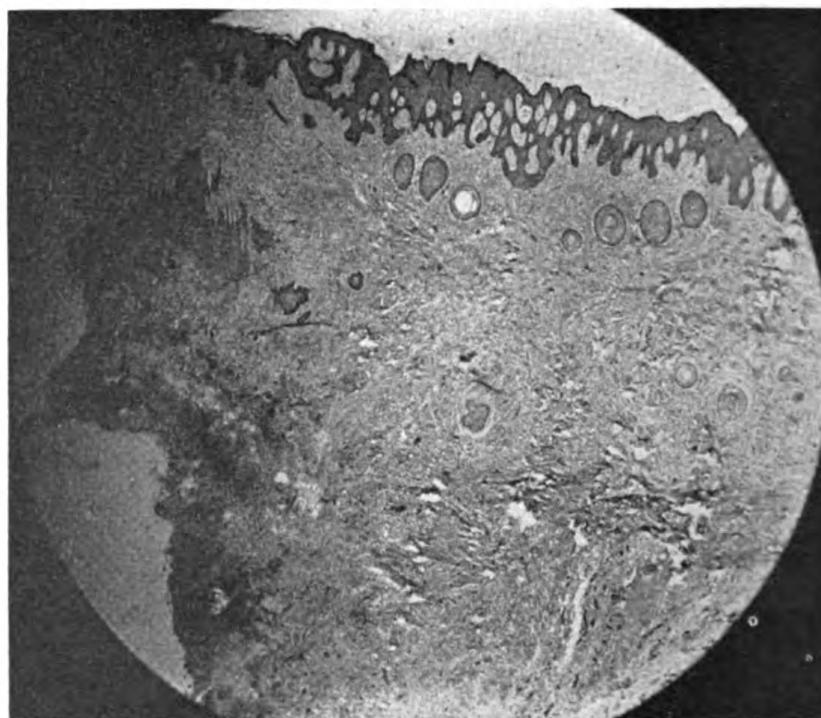
1. A CROSS SECTION OF A TYPICAL CYST. THE CYST WALL IS FIBROTIC AND ENCLOSES MANY DEGENERATING HAIRS, AROUND WHICH MAY BE SEEN SEVERAL FOREIGN BODY GIANT CELLS. THERE IS A MODERATE INFILTRATION WITH POLYMORPHONUCLEAR AND LARGE MONONUCLEAR CELLS.



2. A CROSS SECTION OF A PILONIDAL SINUS TRACT SHOWING THE SQUAMOUS EPITHELIUM LINING THE TRACT AND SURROUNDED BY DENSE, CHRONICALLY INFLAMED FIBROUS TISSUE. THIS CASE HAD NEVER BEEN INFLAMED, CONSEQUENTLY, EPITHELIUM IS STILL PRESENT.



3. A HIGHER POWER OF FIGURE 2 SHOWING PARTICLES OF DEGENERATING LANUGO HAIR IN THE LUMEN. NOTE ABSENCE OF ACCESSORY SKIN STRUCTURES, I. E., SWEAT GLANDS, ETC.



4. SECTION IS FROM THE SPECIMEN OF A RECURRENT CASE. NOTE THE SQUAMOUS EPITHELIUM AND HAIR FOLLICLES EMBEDDED IN A DENSE, FIBROUS SCAR. THE LINING WALL OF THE ABSCESS CAVITY IS ON THE LEFT.

studied, but no sebaceous or sweat glands definitely related to stratified squamous epithelium lining the sinus tract of cyst could be found (2).

The case in which sections were taken from tissue removed at the second excision (recurrence in 5 months) is of interest. Typical stratified squamous epithelium, hair, and follicles were seen in the central part of the old operative scar, with many foreign body giant cells around hair fragments (fig. 4). From this pathologic picture it is obvious that care in excision of the ramifications of the sinus is a prime requisite.

None of the sections revealed any tissue that could be described as neural in origin.

DIAGNOSIS

The diagnosis of pilonidal cyst is not difficult if the lesion is looked for when rectal examination is done. If in an inflamed state the diagnosis is easy. The history of recurrent pain in the sacrococcygeal region, or sitting pain and discharge is sufficiently leading. A lump, abscess, or indurated zone at the sacrococcygeal junction should lead the examiner to think of pilonidal cyst. The presence of a small sinus with hair protruding from the orifice and a discharge on gentle pressure is diagnostic. In rare cases the defect deviates to the left or right of the midline and in such patients an extensive lesion may be expected. Probing the sinus tract is an unnecessary procedure unless operation is to follow within 12 hours. Two of our cases were complicated by "stirring up" the inflammatory process in this manner.

The differential diagnosis has been enumerated many times and will be given in order of importance. (1) Anorectal fistula can be excluded by probing, with a finger in the rectum, thereby determining the direction of the sinus and whether or not it communicates with the anal canal. Usually the fistula has a caudal direction while the pilonidal sinus has a cephalad direction. (2) Furuncles and carbuncles are acute, and can be differentiated by the lack of a sinus and by their superficial location. (3) Osteomyelitis, tuberculosis, syphilis or other infections of the osseous structures can be ruled out by history, serology, and roentgen examination. (4) A sebaceous cyst in this region would be difficult to diagnose if inflamed. (5) Chordomas and teratomas are very rare but may have to be considered.

TREATMENT

The treatment of this lesion has always been remarkable for diversity of opinion, radical departures, and poor results. Often it seems that primary healing was accomplished by "wand-waving"

rather than by observing the doctrine of good surgical principles. Delayed healing and recurrence are still the primary problems facing us. From the pathology it is easy to see that *complete* and clean dissection is needed as the first principle. If any of the glands, hair follicles or old scar tissue is left behind and sewed in the wound, a recurrence is not only to be expected but can nearly be foretold. The time is very variable as to recurrence but in this series it varied from 3 months to 19 months.

Ambulatory treatment has no place in the Navy, although the use of caustics has been recommended by some. For service purposes, and for the best results, hospitalization is the choice of most surgeons. Incision and drainage for infected cases followed by excision when the infection is under control is accepted. Excision and primary closure has been the goal, but excision and pack with or without partial closure, has been the compromise method most widely used. Primary closure with a drain is a further compromise.

The latest such method is that of DePrizio (9). He reduced the healing time from 78 to 32 days as compared with packing. In the main, the procedure is to do a block dissection and eliminate dead space by suturing the skin margins to the sacral fascia. This leaves a hollow defect with about $\frac{1}{4}$ inch of open wound to allow for drainage. Sulfathiazole was used with an iodoform pack in the hollow defect.

RESULTS

The 50 cases were distributed for treatment as seen in table 5. Six of these patients had been operated upon one or two times; the rest for the first time. Spinal procaine was used in 35 cases, local in 10 cases, intravenous pentothal in 3 cases, and caudal with procaine in 2 cases. There were no deaths in the series.

That this lesion is not a problem from the lethal and invaliding standpoint can be seen from the accumulated figures of the period 1930 to 1940. During those years only 5 deaths were attributed to this lesion and 21 cases were invalidated from the service. No cases in our series were invalidated.

TABLE 5.—*Operative procedures*

Treatment used	Number cases treated	Average number of sick days	Percent of total cases
Incision and drainage.....	3	14	6
Excision and packing.....	10	46	20
Excision, partial closure, and packing.....	1	64	2
Excision, primary closure.....	36	47	72

Incision and drainage was used in 2 cases for relief of symptoms, and in 5 other cases as preparation for excision. Excision was done in 11 cases, 10 of which were packed and 1 partially closed and packed. The cases that were packed included the markedly and acutely infected cases. Thirty-six cases were excised and closed by primary suture. Methylene blue (2) was used 8 times to delineate the sinus tracts. Nearly all excisions were done by means of an elliptical incision over the diseased area and dissection down to the sacral fascia. The coccyx or sacrum was not involved in any case. Six cases required extensive plastic procedures because of extension of the sinus tract into either the right or left buttock. In 35 cases sulfanilamide in amounts varying from 1 to 4 gm. was salted or placed into the wound, 24 of which were followed by primary suture.

In table 5 the results of treatment are compared. It will be seen that those cases treated by excision and primary closure totaled 72 percent with an average number of sick days of 47. This compares with an average of 46 sick days for the excision and pack method. However, when those 11 cases that were complicated by other factors² are omitted, another story is apparent. When this is done, a total of 25 uncomplicated cases were treated by excision, primary suture, and sulfanilamide. The average number of days per case thus becomes 29 instead of 47.

Postoperative treatment was routine for pain. The bowels were allowed to move on the third day. Sitz baths were used in those cases that healed by primary intention for symptomatic relief, and were quite helpful. In the protracted cases that required dressing, azo-chloramid and sulfanilamide were used on the pack (12). In the infected wounds this produced very good results. In an unpublished work Scott (13) concludes:

The use of buffered sulfanilamide powder dusted into the wound at the time of operation has markedly reduced the percentage of postoperative wound infections, which effect plain sulfanilamide alone failed to produce.

Scott reports on 94 cases of pilonidal sinus in which primary closure was done in all. Twenty-eight cases dusted with 0.5 to 1.5 gm. of "buffered sulfanilamide" prepared with 10 percent calcium carbonate resulted in an average healing time of 18 days with 1 infection. Using the same technic on 29 cases without the buffered sulfanilamide resulted in an average of 24.8 days hospitalization with 8 infections.

Complications occurred in 4 cases that were not related to the lesion, i. e., postoperative pneumonia, postoperative delirium, renal colic, and spontaneous pneumothorax. In 11 cases complications due to the

² Total sick days uncomplicated cases: 732 in 25 cases. Total sick days complicated cases: 966 in 11 cases.

local condition were as follows: Hemorrhage after incision and drainage 1, hematomata 2, a fall to the deck breaking open the wound 1, infection 1, and in 2 cases remnants of cyst produced a recurrence necessitating reoperation. Four cases were found to have extensive intercommunicating ramifications.

DISCUSSION

From this series of cases it can be seen that a standardized method of treatment, where possible, combining primary closure and sulfanilamide, should be used. The physical examination qualifications for enlistment should make clear the status of pilonidal cyst. At present, pars. 1498 and 1499 of the Manual of the Medical Department do not establish this condition as disqualifying. The question is an open one regarding rehabilitation, but from a statistical viewpoint it would seem that the cost of hospitalization is high, especially in this period when every available bed is needed.

Sulfanilamide, as a prophylactic against infection, has a real place in the treatment of this lesion. From Scott's work it appears the buffered drug is more efficacious. The amount used appears to be a factor, i. e., 0.5 gm. to 1.0 gm. is the *correct* quantity. Any larger amount is only wasted on such a small operative field. Primary closure should be tried in all, using a procedure that conserves the normal structures but allows a complete excision of the lesion. The wound should then be treated as any other sutured surgical incision.

Acknowledgement.—Grateful acknowledgement is made to Lt. Comdr. C. F. Geschickter (MC), USNR, for his helpful suggestions and expert advice.

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ABSORPTION OF SULFANILAMIDE APPLIED LOCALLY

Local application of sulfanilamide in wounds resulted in blood concentrations of somewhere near 1 mg. per 100 cc. for each gram deposited in wound. It is possible to get too high a blood level through absorption from a wound.—Hodgson, A. R., and Robinson, J. R.: Absorption of sulfanilamide applied locally; blood levels in 41 cases. *Lancet* 2: 392-394, Oct. 3, 1942.



ANTISEPTIC IDEALS

An effective antiseptic should possess the following capabilities:

1. In the strength used, it should kill germs if diluted at least two to four times more.
2. It should retain most of its germicidal ability in the presence of serum, blood, and crushed tissue, as well as miscellaneous dirt.
3. The essential chemical should not react with the tissue juices or blood and thereby be rendered inert.
4. It should not be a protein coagulant like phenol because on application a scum of coagulum might bridge over microscopic pockets and prevent the deeper penetration of the antiseptic.
5. It should interfere to a minimum with the power of the blood by its leucocytes and the tissues to deal with organisms not killed by the antiseptic.
6. It would be desirable if the antiseptic should cross cell membranes and kill organisms which had somewhat invaded the tissues. It seems probable that no antiseptic has this power to a useful degree.
7. It should be nonselective toward various bacteria. All the antiseptics to be considered are fairly nonselective, but the coal tar derivatives, dettol and amaryl, like phenol, show minimum selectivity.
8. The product should be sufficiently inexpensive that one will feel no hesitation in using as much as desired.
9. It should be of proved clinical value.—Beath, T.: The suppression of infection in recent wounds by the use of antiseptics. *Surgery* 13: 667, 1943.

OBSERVATIONS ON PILONIDAL CYSTS

RAYMOND G. JACOBS

Lieutenant Commander (MC) U. S. N. R.

In civilian practice, there is a relative absence of infection of pilonidal cysts except in truck and taxicab drivers. Attention has been called to its frequency in cowboys. There is general agreement that such infection in naval personnel is aggravated by trauma from hard bunks, decks, iron benches, and arduous duty. In the San Diego Naval Hospital, we operated upon 65 cases, trying 3 types of flap operations without any outstanding results. There was nothing remarkable about the technic except the use of local anesthesia. This almost eliminates the troublesome surface bleeding.

The 65 cases were divided into three groups of 42, 18, and 6 on which we used the various methods of closure. In this series, the total number of hospital days were 73, 71, and 78 respectively. Certainly nothing remarkable resulted except that we agreed that the long restriction in bed, local discomfort, and uniformly small number of primary healings did not justify our method of closure.

With our results still so unsatisfactory, I was transferred to a field hospital with the Fleet Marine Force. Some months later in the quiet intervals between sea battles in the Solomon Islands area, I again came in contact with this type of case. The incidence of infection and drainage was nearly 100 percent. Remembering that the fundamental principle in the treatment of purulent infection is adequate drainage, this we adopted in the field hospital. Under local anesthesia, the entire dome of the infected cavity and all lateral extensions were excised. Emphasis was placed on the importance of removing completely the roof with the adherent purulent sinus wall. A gauze sheet filled with sulfanilamide powder was packed in the wound and not disturbed on the average for 72 hours. After the first 24 hours, the patient was permitted to be out of bed.

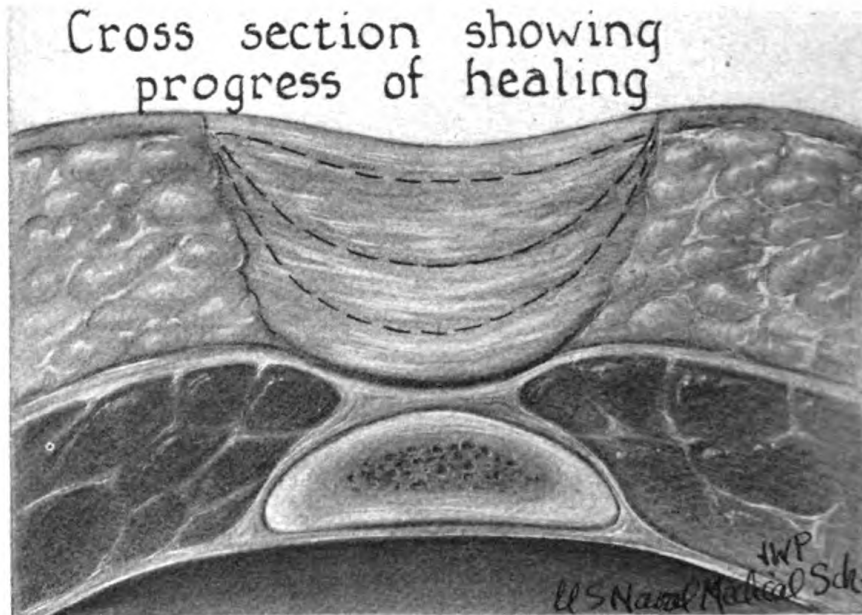
After the edema and the hardness of the adjacent tissue had disappeared, the remnant of the cyst wall and sinus tract was daily cauterized to whiteness with full strength phenol on a wood applicator. An alcohol pack was then inserted. We used phenol, for it was the only chemical we had and it also was a simple and painless procedure. This was continued until the cavity wall was entirely destroyed and then healing permitted to continue under observation. The number of hospital days averaged approximately 50 per



1. EXCISION OF CYST.

case. Noteworthy observations were the lack of discomfort and pain; ability to work in the ward after 48 hours; absence of post-operative infection; and the firm healing with contraction of the resultant scar.

In the field, we have learned again that a fundamental principle of good surgery is simplicity of operation. Our physical equipment made this limitation necessary. The method described embraces the above principle. Because of the high degree of local infection in these cases, I am convinced that our efforts to speed up healing by primary closure have been wrong. Certainly a surgeon would not recommend total excision of an abscess and yet that is what we have been doing.



2. DIAGRAMMATIC CROSS SECTION OF HEALING.

Another observation that interested us was what happened to the fat attached to the flap transferred over the sacrum. Approximately 4 to 6 months later, this adipose layer disappeared.

Should these men be admitted to the Navy? The Medical Department is partially justified in suggesting rejection from the service but it is not fair to the recruit. However, there is a halfway solution to this problem. These cases should be recognized in the recruiting station and the great probability of infection requiring surgery should be explained to them. Enlistment then should be on an EPTE basis, this status not to be vitiated by subsequent naval surgery. The old principle of adequate excision and drainage specifically applies to the majority of pilonidal cases. There is no short cut for a cure. Any attempt will result in a high degree of complication and postoperative infection. A very small number of rare noninfected cases will respond to primary closure if there is no tension.

COMBAT FATIGUE AND WAR NEUROSIS

(CONCLUDED)

GEORGE N. RAINES
Commander (MC) U. S. N.

and

LAWRENCE C. KOLB
Lieutenant (MC) U. S. N. R.

The first section of this article, in the July number of the *BULLETIN*, presented a discussion of the literature, symptomatology, diagnosis, and etiology of "Combat Fatigue," with two typical cases of this disability. The following cases illustrate more severe examples of "combat fatigue," and its differential diagnosis from other common neuropsychiatric disorders.

CASE REPORTS (*Continued*)

Case 3.—This 24-year-old lieutenant had 1 year and 16 days active duty in the United States Marine Corps prior to his admission to this hospital for study concerning an "emotional instability."

At birth he lost his mother and was placed in the hands of an aggressive but affectionate aunt and a colorless uncle. As the only child in the home he was pampered and spoiled, but at the age of 18 years decided to return to his very successful father, who had meanwhile married and had two children by his second wife. The readjustment was difficult but successful; at first he felt resentment toward his stepmother, who seemed unduly critical and appeared to discriminate against him. He entered college in accordance with his father's wish. He pursued a dilatory course, though active in athletics and social affairs. However, on the side, he methodically and conscientiously carried out a research program for a chemical company as a means of obtaining funds for himself.

The patient left college to enter Marine Corps aviation when the opportunity presented. He had had over 200 flight hours prior to his transfer to a Pacific island base in April of 1942. There, due to equipment limitations, the group obtained only a few hours flight per month and did not have the opportunity of combat practice as a unit. He was quartered with, and became unusually close to, his commanding officer. The patient was a member of the dive bomber unit attacking the Japanese fleet in June. His oldest companions in the squadron were shot down in flames before his eyes, his commander and a large proportion of the squadron were lost. He put his bomb on an aircraft carrier before returning to base and then was exposed to shelling by a submarine during the following night. Shortly after the return of the survivors, both he and his surviving squadron mates presented evidence of an intense emotional reaction. He was restless, tense, irritable, and unable to sleep. At night he repeatedly recapitulated the horrifying combat experience in dreams and during the day was unduly upset by sounds reminiscent of bombing. He commenced to drink, was morose, reticent, and irresponsible, and ignored the

usual courtesies given senior officers. His confidence in his flying ability disappeared, he was fearful of killing himself or others, and repeatedly considered various schemes for self-injury in order to escape from the distressing situation. Following a rebuke by his commanding officer, after collision of a plane in his three-plane section with an Army plane, his anxiety became so marked that he demanded to be transferred to an Infantry company. In rapid succession he received three changes of station in the succeeding 4 months, finally ending in an Infantry company. These transfers served further to undermine his security; he believed from comments made that an effort was being made to oust him from the corps.

On admission to the hospital he was anxious, restless, overactive, and sleeping poorly. He had feelings of guilt and was sheepish over a recent award of the Navy Cross. He stated that he was unable to attend movies containing battle scenes. "The first thing you know, you are right up there in it." Under treatment the patient regained his composure, was again affable, enthusiastic, assured, and pleasant. The nightmares subsided, startle was less pronounced, he was able to attend movies, resumed aviation gunnery practice, and repeatedly expressed his desire to return to aviation though not certain of his ability to perform as a fighter pilot. Accordingly after 3 months he was brought before a Board of Medical Survey and recommended for return to limited active duty with ground aviation for a minimum of 6 months prior to reconsideration for flight duties. The diagnosis was combat fatigue.

Comment.—This rather immature lieutenant, previously without symptoms of emotional instability, with an inadequate training period prior to a dive bombing attack in which his commanding officer was killed, developed nightmares, anxiety, response to startle or to recapitulations of combat scenes in movies, and a personality change characterized by morose irritability, alcoholism, irresponsibility, insecurity, and lack of confidence. The symptoms were aggravated by the undermining influences of a rapidly changing environment and of an unsympathetic, misunderstanding attitude of both medical and line officers who contacted him following the combat experience.

Case 4.—This 17-year-old seaman had 7 months' active duty prior to his admission to the hospital with an undetermined diagnosis of intracranial injury.

He is the third of four boys in a family of six. His father is a "shell-shocked" veteran of the last war, now alcoholic and a chronic complainer. The mother is migrainous. The home was kept discordant by parental quarrels; nevertheless, the patient, though of retiring and quiet nature, adjusted well at school, was accepted by his classmates, and was not considered temperamentally unstable.

Following his enlistment in the naval service, he received 3 weeks basic training and was detailed aboard a transport for drill in amphibious operations. The patient had hoped for duty aboard a combat ship of the line. Three weeks prior to the departure of the convoys for the North African engagement, he was transferred to another ship. There he was barely acquainted with his new shipmates when the engagement opened. His immediate chief was regarded by him with little respect as an "old man." The seaman was extremely apprehensive as his landing boat approached the beach during the opening operations, but quickly regained composure when not exposed to fire. The following day he was frightened to the point of believing his legs were paralyzed when an enemy plane strafed the ship and he threw himself on the deck. The fourth day the ship was suddenly torpedoed. He was blown against the bulkhead and struck his head, but was not injured and quickly climbed down a net into a

tank lighter below. While throwing out lines to men struggling in the water he was fascinated by their cries and amazed to see some cast aside their life jackets. After helping one man aboard the patient felt so weak that he lay upon the deck and later had to be assisted ashore. The following day a plane killed a French woman in town and he morbidly examined her body and the leg wounds of a sailor wounded in the same raid. He then realized how tense and anxious he felt, and in the following weeks had difficulty in sleeping, being repeatedly awakened by dreams in which his ship was torpedoed or he was shot in the leg. While aboard the transport returning home, he and the men in his division were quartered in a forward compartment. During a prolonged storm the group repeatedly rushed to the boat deck in panic when a loose hatch cover slammed above them. He was given a 30-day leave after arriving in this country but the change in his personality was so conspicuous to his family that his mother shortly sought medical advice concerning his symptoms.

On return to duty the patient complained of headaches and dizziness, and was transferred to this hospital for study. As there was no evidence of organic disease, psychiatric examination was requested. His extreme restlessness, amounting to agitation, his inattentiveness and irritability were immediately apparent. He was unable to concentrate, expressed death fears, and presented the history of nightmares and sensitivity to sounds reminiscent of combat. His sleep was broken almost nightly by terrifying dreams. With sedation and psychotherapy there was some diminution in the restlessness, the insomnia, and his response to startle. He put on weight, but continued to complain and insisted upon his inability to return to duty. It was evident that he would not again adjust in the service. On a mental test he attained an intelligence quotient of only 69. Accordingly, he was brought before a Board of Medical Survey and recommended for discharge under the diagnosis of psychoneurosis, anxiety neurosis, incurred in the line of duty.

Comment.—This dependent, youthful seaman, with a dull mentality, who was raised in a discordant home by a neurotic, alcoholic father and a high-strung mother, presented no evidence of emotional instability prior to his traumatic combat experience. He then developed nightmares, startle, and a personality change marked by agitation, anxiety, and preoccupation, with the complaints of headaches and dizziness. The case study illustrates the importance of a psychopathic background, and the contributing factors of inadequate training, indifference to leadership, and low morale. The repeated panics during the voyage home have probably further served to deepen the patient's anxiety by the process of conditioning.

Case 5.—This 28-year-old corporal had 2 years and 4 months service in the United States Marine Corps prior to his admission to this hospital.

He is the youngest of five children. The brother now is in the naval service and the three sisters are married. The father is a successful Illinois farmer, the mother suffers hypertension and is irritable and fretful. The patient is his mother's favorite. His childhood was not unusual; he completed grade school at 15 with an average record and worked steadily as a laborer or a farmer until his enlistment in the Marine Corps. His sexual life has been promiscuous and he has not married. A review of his health record showed that the patient had requested medical study on June 13, 1941, following three acute attacks of palpitation associated with vague apprehension of death. As no medical cause could be discovered for his symptoms he was returned to duty with the statement that the complaints were regarded as "functional in origin." Sedatives were prescribed for treatment.

The patient was a member of a Marine unit at the time that the Japanese attacked Pearl Harbor. As he and members of his company were leaving the mess hall they observed some planes dropping torpedoes and thought that they were witnessing a sham maneuver until explosions took place and the planes commenced to strafe the fields. The patient, with some companions, immediately rushed to a storeroom, broke out a machine gun, mounted it near the hospital, and manned the gun during the succeeding attack. He witnessed the explosion of the U. S. S. *Arizona*, saw men in his company shot down by the strafing planes, and was later nauseated as the burned and maimed were carried into the nearby hospital. For the next 36 hours his company was busy preparing and manning machine gun positions upon the beach while awaiting an expected invasion. The company was kept active for a period of 3 weeks and as the tension decreased the patient developed anxiety, was unable to sleep well, commenced to have nightmares which awakened him in extreme apprehension with palpitation, choking, and dyspnea. Following exposure to any sharp sound suggestive of an air raid he felt weak, sick, tremulous, and perspired freely. He made no complaint and continued duty. As his symptoms persisted for months after his evacuation to this country he became morose, irritable, restless, depressed, and fearful of developing a "nervous breakdown." For this reason, the patient sought medical advice in October 1942, 10 months after his combat experience.

On admission to the hospital there was no evidence of physical disease. He was conspicuously restless, tense, anxious, resentful and irritable, and easily startled by slight sounds. Careful observations of his sleep disclosed that he had difficulty initiating sleep and then frequently awoke during the night. The patient was unwilling to discuss his experience at Pearl Harbor though induced to give a chronological account of his activities. He was thought to be actively repressing certain of his experiences and never produced dream content.

With psychotherapy and sedation, he became more composed, was able to perform simple details about the hospital compound, gained weight, slept soundly, and conversed with ease on other subjects than his battle experience. This subject immediately aroused his anxiety, and he became irritable, anxious, flushed, and excited. In spite of continuous treatment over a period of 3 months his improvement was considered insufficient to allow his return to even limited duty. Therefore a Board of Medical Survey recommended his discharge under the diagnosis of psychoneurosis, anxiety neurosis, considered to have been incurred in the line of duty.

Comment.—This patient was observed to suffer anxiety seizures many months prior to the outbreak of war. His single battle experience, coming as a surprise and without adequate preparation, resulted in aggravation of this already established neurosis and complicated it by engrafting thereupon a "startle" response to sound and a mild depressive reaction.

Case 6.—This 21-year-old seaman had 7 months' service prior to his admission to this hospital with the complaints of weakness of his legs, nervousness, poor appetite, and inability to sleep.

The patient is one of a large family, of Italian immigrant parentage. Throughout his adolescence he considered himself physically weak and unfit for strenuous physical effort such as athletics. He was a sensitive, retiring individual, and worried about a severe case of acne. Due to his pallid complexion, he thought he had anemia. In the year previous to his enlistment he had attempted to work as a fisherman but after twice suffering severe fright following falls into the sea, gave up this occupation.

On enlistment in the naval service, he was selected for further study by the psychiatrist at the naval training station due to his conspicuous insecurity, but was sent to duty after the receipt of an innocuous social service report. He was then assigned to the Amphibious Force when his recruit training was complete, and was placed aboard a transport. There he repeatedly visited sick call with such complaints as weakness, tension, fatigue, diarrhea, and vomiting, and was actually in bed during the days before his ship approached the North African coast during the original landing operations in November of 1942. The patient however served as a coxswain for one of the landing boats. His transport was torpedoed on the fourth day after the first landing. He immediately went overboard, swam about supported by a life jacket, and was shortly picked up by a barge. No sooner was he grasped than he collapsed, had to be pulled aboard, and was still unable to support himself upon his legs when put ashore several hours later. He was one of the members of the division that was placed in the forward hold of a returning transport where the men repeatedly rushed to the boat deck in panic when a loose hatch cover slammed and led them to fear another torpedoing.

Shortly after his return to this country he was admitted to the hospital with the diagnosis of anemia and the symptoms mentioned above. As there was no clinical evidence of anemia he was returned to duty 14 days later. The patient then received a 31-day survivor leave, but on return to duty complained of weakness of his legs and fatigue. In view of these complaints he was readmitted following interview with a psychiatrist, who regarded the patient as of long standing neurotic make-up and did not consider that his combat experience had aggravated his condition. It is of interest that the patient denied nightmares, was not restless or unduly anxious when exposed to sharp sounds. In spite of treatment and observation over a 2-month period, his complaints persisted and the patient was therefore recommended for discharge from the service by a Board of Medical Survey under the diagnosis of constitutional psychopathic state, emotional instability, which was considered to have existed prior to enlistment.

Comment.—This patient, in spite of a long-standing neurotic complaint, was capable of performing his duties during combat operations but did not develop any of the symptoms of the traumatic state, though exposed to considerable stress. However, following the sinking of his ship, his exposure to combat, and his return to this country, he reproduced the neurotic symptoms that had previously preoccupied him.

Case 7.—This 20-year-old patient, a seaman, second class, had 5 months and 7 days active duty in the United States Naval Reserve prior to his admission to this hospital.

He is the second of five children, the eldest of the three boys. His father is a laborer. As a child the patient was shy and retiring, was unusually sensitive to teasing, had nightmares and walked in his sleep until the age of 12 years, and was enuretic until 9 years old. Following the death of his father, the patient, then 9 years old, fainted after developing palpitation, precordial distress, weakness, and a feeling of anxiety. These symptoms have recurred throughout the intervening years whenever he has been exposed to the stress of frustrating situations. He did poorly in school, with four grade failures, and then accepted employment irregularly. He has since been intermittently alcoholic, always dependent upon his mother, and now upon his wife for security.

He was detailed to a fast minesweeper after 3 weeks training. Two months later the patient was engaged in the landing operations along the North African coast. The patient was posted as lookout. As the ship approached the coast

It was greeted by some gunfire and he saw shells splash in the water several hundred yards away. His heart commenced to pound, the precordial heaviness recurred, and his legs felt weak. He sat down on the deck, thus deserting his post and allowing the other men to carry on without him. As the ship was exposed to no other gunfire and had an otherwise uneventful trip the patient presented no further symptoms until after the return voyage to the United States. Then he had another similar attack while lying in his bunk in a crowded section of the ship, and due to his obvious discomfort, with complaints relating to his abdomen and chest, he was transferred to this hospital for medical observation.

In the hospital, he presented the history and symptoms recorded above, declared that he was unable to adjust in crowds or noisy situations, and was preoccupied with worry concerning his wife, a chronic invalid. The physical, neurological, and laboratory studies failed to reveal evidence of organic disease but a social service report confirmed the history presented by the patient and further stated that he had "been ill all his life." A test of his mental ability showed that he had an intelligence quotient of 73. Accordingly he was brought before a Board of Medical Survey and recommended for discharge under the diagnosis of constitutional psychopathic state, inadequate personality.

Comment.—This 20-year-old patient with a border-line mental defect and a long history of insecurity and general inadequacy had for many years been preoccupied with somatic complaints relating to his heart which had been recurrently noted in emotionally distressing situations. This neurotic complaint caused him to desert his post aboard ship at the onset of battle operations but fortunately this act did not result in serious consequences to others. At no time was he exposed to a combat situation sufficient to produce combat fatigue.

Case 8.—This 31-year-old ensign had 7 months and 21 days active duty in the United States Naval Reserve prior to his admission to the hospital with a simple fracture of the twelfth dorsal vertebra.

He is the only son of a successful, energetic, and righteous businessman, and was happily brought up by his stepmother after his mother lost her life when the patient was 6 years of age. An average student at school, he entered the merchant marine at the age of 17 years and had worked his way to a first officer's license by the time he was 25 years. Then the patient married and accepted a position ashore as a foreman of stevedore gangs. In 1938, while at this job, he became depressed, slept poorly, had feelings of inadequacy, felt excessively fatigued, and experienced crying spells throughout a period of 12 months. He did not seek medical care, and blamed his mood disturbance entirely upon overwork and the type of people with whom he had to associate. He quickly recovered after impulsively quitting this job, and was performing in a highly successful manner as a salesman when he reenlisted in the United States Naval Reserve. His previous commission had been canceled at the time he discontinued going to sea.

The patient was immediately placed aboard an armed transport and in spite of his junior rank was given considerable responsibility because of his previous experience at sea. He was the assistant to the executive officer, stood senior watches, arranged battle drill, and was placed in charge of the after 5-inch gun. In August of 1942, while the ship was running trials, he again felt run-down and fatigued, and was at times so depressed that he had uncontrollable weeping spells. For this reason, he spent a full week in bed in the sickbay. Nevertheless, he resumed his duties when the ship joined the North African invasion fleet. Early one morning, nearing the African coast, the ship was struck by a torpedo which exploded the after magazine, wrecked his gun, and threw him

into the air some 15 feet. In spite of fracturing his back, he ordered his men to another gun, and painfully dragged himself into the wrecked compartment below, from which steam was escaping and where he heard the cries of injured men. There he was shocked by contact with the mangled and dismembered bodies of his own men. A half hour later the patient entered the sickbay in shock secondary to the back injury but recovered quickly and was again at his post 2 days later. Throughout the succeeding 3 weeks the ship was bombed daily by planes, and eventually was thrown upon the rocks during a severe storm. The repeated calls to general quarters, the fear of sinking, loss of sleep, and continuous responsibility led to deepening depression, and restless sleep. He began to dream of bombing and sinkings, of general quarters alarm, and frequently awakened with a start. There was a recurrence of an anxiety nightmare that he had in childhood. Sharp sounds led to acute anxiety. Following his eventual collapse from the excruciating pain in his back, and the x-ray discovery of the fracture 3 weeks after the injury, he was evacuated to this country. While aboard the returning transport the patient learned that the men on this ship were not stationed in the magazine in the manner that he had arranged for his crews. The already existing guilt feelings concerning the death of his men were magnified.

The return to this country was first followed by relief, but shortly after his admission to this hospital he again felt tense, fearful, apprehensive, depressed, and insomniac, and the nightmares recurred. He was anxious when planes flew overhead or when sirens or whistles were heard, and was unable to attend movies due to his self-identification with the actors. In particular, he plunged himself into the movie, "Caught in the Draft," and instead of laughing at this comedy, left, tortured by the fear of the hero who was to be forced into gunfire. He was self-accusatory, declared himself a coward, and expressed a hatred of the sea and the service and all that went with it. Only when at home on leave from the hospital did the patient feel happy and as the day of return approached there was a quick resurgence of the depression. As he failed to improve under treatment and was considered to be suffering a depressive psychosis complicated by his combat experience, he was recommended for prolonged hospital care and eventual retirement by a Board of Medical Survey.

Comment.—This commissioned officer had a depressive episode of the manic depressive type 4 years prior to reporting for active duty and was entering another attack 2 months before exposure to combat. This second depression, which at its onset consisted of feelings of fatigue and despondency, and short periods of uncontrolled weeping, was aggravated after a horrifying combat experience, and complicated by the characteristic startle reaction to sound and by nightmares. These dreams consisted not only of simple war recapitulations, but also of childhood anxieties. Here the combat-induced emotional disturbance became incorporated in an incipient major psychosis.

TREATMENT

The preventive treatment has been clearly indicated in the foregoing. Little of it lies in the hands of the medical officer. All men placed in a position of even small responsibility should be carefully scrutinized with regard to their fitness therefor. Particularly, officers should be selected with the greatest of care. Any officer who creates a feeling of distrust in the men under him should be removed

at once, and the causes behind the impression should be examined carefully. Commanding officers should be most ruthless in weeding out inapt officers and those who perform poorly under fire. Adequate, competent officers, more than any other single factor, will prevent the occurrence of acute psychiatric casualties during combat and the presence of combat fatigue in the crew.

Men need thorough training in all aspects of their work before engaging in actual combat. Any method of increasing training adequacy will greatly increase the effectiveness of the ship in combat on psychological grounds alone. The medical officer should assure himself that his own corpsmen are thoroughly drilled in the duties of their department, and, in addition, should see that the remainder of the crew are completely indoctrinated in the principles of first aid. Nowhere more than in the psychiatric casualties of war is it demonstrated that knowledge helps to banish fear.

No ship should attempt to meet combat conditions until the crew has been assembled for a reasonable length of time, and the men have come to know each other fairly well. To do so is to invite disaster. Wherever possible, crews should be assembled early in the fitting out of the ship, and kept together thereafter. As a matter of policy, shifting of men from one unit to another should be kept to an absolute, unavoidable, minimum.

That fatigue should be avoided as far as possible goes without saying. Unfortunately, this extremely important point, as a general rule, is beyond the control of anyone. It is almost axiomatic in today's war that men are pushed to the very limits of their physical tolerance, and sometimes beyond. Ships' officers, however, should see that every opportunity to obtain needed rest is seized upon, and where combat is expected in the near future, all subsidiary work should be scheduled in such a way as to allow the maximum amount of rest to each man on board. When circumstances permit, directed recreational activities should be utilized to prevent the psychological fatigue known as staleness. Naval units are considerably more fortunate in this respect than land troops, and every possible advantage should be taken of this good fortune.

These preventive measures are recognized and subscribed to by the Navy. It is obvious that not all can be provided in any given situation, and that these things must be modified by the exigencies of war. We may expect a certain percentage of psychiatric casualties from all engagements. Should, however, any ship show an unusually high incidence of combat fatigue, the circumstances surrounding the engagement should be investigated at once, with particular reference to the factors mentioned. It must be remembered that whenever a large number of casualties have arrived in a hospital from

a given ship, there are surely a great many more who did not seek medical aid, and who are exposing some other ship to the damaging influence of their contagious panic. In dealing with the neuroses of war, we find that "morale" is not some ethereal myth, but a tangible problem composed chiefly of sound leadership, good training, familiarity with shipmates, and lack of fatigue. Unless these conditions are met, no amount of propaganda will raise morale.

The active therapy of combat fatigue is relatively simple and quite effective. The primary indications are two: Rest and emotional desensitization of the patient to the traumatic experience. Rest is obtained by the use of barbiturates with a free hand, and with them it is possible to manage cases on board combatant ships long before they reach a hospital; as a matter of fact, if properly handled, many may never need hospitalization. There is no sleight of hand or secret about the use of the drugs; remembering the toxic limitations, enough is given to put the patient asleep and keep him asleep. Just how long a period of rest is needed early, no one can say; the indications must be met for the individual. An immediate rest period of at least 48 hours probably is advisable, although, of course, a less extensive time will have some value if the longer period is rendered impossible by operating conditions. Patients kept asleep longer than 48 hours will need special nursing care to prevent pulmonary complications, and special attention to feeding and fluids. It is seldom necessary to carry out such a prolonged period of narcosis, and in cases where indicated, it probably would be safer to allow the patient a waking interval of 12 hours before further narcosis while he is still on board ship. In hospitals, of course, any degree of prolonged narcosis can be carried out in accordance with the established routines. Most medical officers will be tremendously surprised to see the enormous improvement in their so-called "neurotics" after this prescribed period of rest.

Regardless of the improvement obtained by rest, the emotional desensitization should be begun immediately thereafter. For the successful management of any case a sympathetic attitude on the part of medical personnel in attendance is indispensable. Too many such patients have been accused of "gold-bricking" or have been ignored. Emotional desensitization consists simply of encouraging the patient to tell of his combat experience in an atmosphere of mutual understanding and respect. In a great many cases seen aboard ship, the patients themselves will accomplish much of this if grouped together, thus more or less treating each other. If time permits, each patient should be allowed to tell his story to the medical officer at least once, and the doctor should note what elements in the story are most disturbing to the individual. With an eye on the objective evidence of tension and anxiety, the medical officer can soon tell which of his

patients are well, which need more attention from him to recover on board ship, and which will have to be evacuated. He will find his time well spent; a number of men will be saved for the ship, and others will avoid a long disablement.

A certain percentage of cases will require evacuation from the ship to improve. In this regard attention is invited again to the maxim that the farther from the front line a patient moves, the more difficult it becomes therapeutically to return him to combat duty. Early, accurate diagnosis is therefore imperative. Every effort should be made to give each patient sufficient therapy in the first hospital he reaches, without repeated evacuations farther and farther from action. Once recovered, he can be moved away from the front line with less danger of recurrence and of fixation of the symptoms. The therapy given in hospitals is simply a continuation of that outlined. The patient should be seen by a psychiatrist in daily interviews of not less than 30 minutes at first, decreasing in frequency as indicated. Prolonged therapy is not necessary in pure combat fatigue; cases which do not respond with some rapidity to rather superficial discussion of the combat experience and its relationship to the individual patient, will not recover sufficiently to return to duty under any form of therapy, and should be moved on toward a point where they can receive prolonged therapy.

In this connection, a previously mentioned corollary of treatment is important; men should be given a certain period of time to "digest" the emotional turmoil of one traumatic experience before being exposed to another. This is important even in the ship's company which produces no profound combat fatigue, and should be accomplished where possible. It is urgently necessary for patients who have suffered with the fully developed syndrome of nightmares, startle, and personality change. In these latter cases, it is best accomplished in a center where directed recreation and physical work are available, and not in the overprotective, emotionally charged atmosphere of their homes which they meet on survivors' leave. No leave should be permitted any man who suffers with these symptoms. Regardless of other considerations, including his own and his family's demands, he should be sleeping well, having no nightmares, and exhibiting no startle reaction before he is allowed leave. The reasons for this have been pointed out and demonstrated in the cases presented.

The disposition of cases has been suggested at every point. Those who have suffered with uncomplicated combat fatigue and who have recovered in 2 to 3 months of treatment, or less, are good material for retention in the service. As a general rule, they should be returned to the duty they feel capable of handling. Those who have recovered on board their ships need never leave them; those who have recovered

in hospitals near the action may return to their units after a period of controlled rest and relaxation as described; those who have been evacuated to the continental United States, should be returned to limited duty ashore for not less than 6 months, by a Board of Medical Survey. Each recurrence of the symptoms of combat fatigue darkens the prognosis for that attack, and renders return to combat duty less likely. Men who have had limited duty ashore prescribed should be reexamined after 6 months to determine their fitness for sea, if their services are needed again for combat duty.

Again it is pointed out that the occurrence of symptoms of conversion hysteria, and the occurrence of anxiety, not connected with startle, are of bad omen. These men will eventually reach hospitals in the United States, where they will be found very unresponsive to treatment until their discharge from the naval service is assured. They should be treated, and intensively, to prevent their permanent disablement. The therapeutic methods advanced by Kardiner appear to be the methods of choice for these individuals. Even after recovery, they are not suitable for retention in the military service, and should be brought before a Board of Medical Survey for discharge. Their discharge need not wait recovery; frequently the Survey Board is the therapeutic agent necessary to initiate recovery. Under governmental organization, the Veterans' Administration is charged with the rehabilitation of these men, and arrangements should be made for them to receive the proper treatment from this agency. The Naval Medical Corps at this time has its hands full in accomplishing its primary objective, that of maintaining a physically effective fighting fleet.



ENVIRONMENTAL TEMPERATURE AND SURGICAL SHOCK

It is probable that the factor of environmental temperature has been exaggerated. Sometimes extreme measures are taken at great trouble, to supply external heat. Yet it is not entirely certain that the patient in shock, unless his body temperature (not skin temperature) is actually below normal, requires an environmental temperature much above that which has probably been assumed to be a clear indication for heat therapy, is the result of a protective vasoconstriction in compensation for deficient blood volume, and not closely related to impaired temperature regulation. Apparent clinical benefit from heat therapy evidenced by recovery of skin warmth is perhaps spurious. Certainly any success in elevating the body temperature connotes an increase in the metabolic rate and in the oxygen requirement of the patient; this increases correspondingly the task of the already laboring circulatory system.—Nash, C. C.: *Surgical Physiology*. Charles C. Thomas, Springfield, Ill. 1942. Pp. 35-56.

ELECTROENCEPHALOGRAPHY IN THE SELECTION OF NAVAL RECRUITS ¹

PHILIP SOLOMON

Lieutenant Commander (MC) U. S. N. R.

HERBERT I. HARRIS

Lieutenant Commander (MC) U. S. N. R.

CECIL L. WITTON

Lieutenant Commander (MC) U. S. N. R.

and

WILLIAM A. HUNT

Lieutenant Commander H-V(S) U. S. N. R.

Introduction.—The electroencephalograph has become firmly established as a clinical instrument in the diagnosis of various neuropsychiatric conditions (1) (2). Its use in a naval hospital has been reported in this BULLETIN (3). Recently Harty, Gibbs, and Gibbs have published an electroencephalographic study of 275 recruits at an Army induction center (4). This present paper reports the routine use of the electroencephalograph in the detection of neuropsychiatrically unfit recruits at the U. S. Naval Training Station, Newport, R. I.

The procedures of the Psychiatric Unit at Newport in the detection and elimination of recruits unsuited for Naval service because of neuropsychiatric disorders have been described elsewhere (5) (6). It is sufficient here to note that all recruits are given a brief individual neuropsychiatric examination upon their arrival at this training station. Recruits showing signs of neuropsychiatric disorders are admitted to the psychiatric ward for intensive study and possible discharge from the naval service. This further study is necessary to avoid the discharge of men who actually are fit for service. Much has been said concerning the dangers of overlooking the unfit; too little has been said concerning the serious waste involved in the mistaken elimination of those who can be of service, a mistake which will be committed frequently if discharge from the service is based upon any brief screening process which is not supplemented by some further, careful check.

In the study of cases on the psychiatric ward every available diagnostic aid is utilized. Among these are multiple psychiatric opinions, a period of observation on the ward, social service anamneses, trial duty in company, psychological tests, and various laboratory pro-

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cedures (x-ray examination, basal metabolic determinations, etc.). The electroencephalogram (EEG) is a valuable addition to these diagnostic procedures. It has been used by the Unit since June 1942.

Procedure.—The EEG apparatus used at this station is similar to that used by Gibbs. It has 6 independent channels which record simultaneously from 6 different portions of the brain. The apparatus is installed in specially built rooms. The patient is in a small room which is sound-proofed and electrically shielded, while the recording equipment is in an adjoining room.

The apparatus is operated by two corpsmen who have been trained for the purpose. The electrodes are applied and the patient is placed on a cot. A preliminary record is run for 5 minutes, then the patient is hyperventilated for 3 minutes. A continuous record is taken during hyperventilation and for 5 minutes thereafter. The records are read by members of the staff who have had experience in this field. These records are read "blind," as they have only an identifying number and the age of the patient on them, but no name or history.

The records are read in the usual fashion (1). The appearance of definite diagnostic signs results in the record being classed as abnormal. If the abnormalities are minimal and isolated, the record is considered to be within normal limits and not held to be significant. We class such records as *borderline*, and for all practical purposes they can be considered as negative. As Gibbs (4) has pointed out, such a classification is subjective and empirical.

Since the purpose of this article is to show the importance of the EEG as a diagnostic aid, our records have been classified as being "primary," "secondary," or "incidental," according to their usefulness in making the final diagnosis. A record was considered of *primary* value if it would have been impossible to make the correct decision without it. It was called *secondary* if it contributed to the final decision. The remaining records were classified as *incidental*.

Results.—In the four months since the apparatus was first installed, we have run 442 EEG records on 432 patients. In the same period in which these records were taken there were 3,583 admissions to the neuropsychiatric ward and 1,810 trial duty cases. Thus the EEG was utilized in 8 percent of the total number of cases suspected of some neuropsychiatric disorder.

The diagnoses that were in question in the 432 cases are shown in table 1. It will be noted that epilepsy entered into the diagnostic problem in 353, or 81 percent of the cases (this includes epilepsy and migraine with epileptic components). This is not surprising, since the EEG is of greater diagnostic value in epilepsy than in most other conditions.

TABLE 1.—*Diagnosis in question in 432 cases in which EEG was taken*

Diagnosis	Number of cases	Percent-age	Diagnosis	Number of cases	Percent-age
Epilepsy.....	313	72	Somnambulism.....	12	3
Migraine on epilepsy basis....	40	9	Miscellaneous conditions.....	29	7
Post-traumatic brain disorder....	24	6	Total.....	432	100
Organic feeble-mindedness.....	14	3			

Somnambulism is another condition of peculiar naval significance. An EEG was run on each case because of our observation that somnambulism may be an epileptic manifestation.

If we analyze the records of the 432 cases as to whether they were abnormal, borderline, or normal, we find the following distribution:

Abnormal.....	157 (36 percent)
Borderline.....	49 (11 percent)
Normal.....	226 (53 percent)

A further analysis of these records, made on the basis of their importance in the diagnostic picture, gives this distribution:

Primary.....	44 (10 percent)
Secondary.....	229 (53 percent)
Incidental.....	159 (37 percent)

Since the EEG was of primary diagnostic importance in only 44, or 10 percent of the cases, one might ask whether it is really worthwhile. If one considers, however, that the EEG was of primary importance in each of these cases, and that a single undetected epileptic may cost the Government \$30,000 as a pension case, and, on the other hand, that a false diagnosis of epilepsy may deprive the Navy of the services of a man badly needed in the present wartime shortage of manpower, then the value of the electroencephalograph becomes apparent.

The following is an analysis of the findings according to diagnosis.

Epilepsy.—The EEG naturally has been of greatest value in the diagnosis of epilepsy. Table 2 shows the results of the 313 cases in which a question of epilepsy was involved. It will be seen that in 25 cases (case 1 of the appended case histories) the diagnosis would have been missed without the evidence of the abnormal EEG. In 13 cases

TABLE 2.—*Analysis of 313 cases of suspected epilepsy*

Value of EEG	EEG Diagnosis			Number of cases	Percentage
	Abnormal	Borderline	Normal		
Primary.....	25	0	13	38	12
Secondary.....	87	8	76	171	53
Incidental.....	9	29	66	104	33
Total.....	121 (39%)	37 (12%)	155 (49%)	313	100

(case 2) the diagnosis of epilepsy would have been made mistakenly had not the normal EEG led to a further investigation which ruled out the disorder. In 87 cases (cases 3 and 4) an abnormal EEG was of secondary value in establishing the diagnosis. In 76 cases (case 5) a normal EEG helped in ruling out epilepsy. In 9 cases an abnormal EEG was considered to be only of incidental value, since the diagnosis of epilepsy had been firmly established beforehand through the observation of typical convulsions and the eliciting of characteristic histories. We have since ceased doing a routine EEG in this type of case. It is of interest to note that we have discharged 27 cases (included under incidental) as epileptic in spite of the presence of a normal EEG. In these cases the clinical picture without the EEG was diagnostic. It is well recognized that some epileptics may have a normal EEG between seizures. These cases represent 22 percent of a total 121 cases that were discharged as epileptic. In summary, we find that the EEG was of primary or secondary value in 67 percent of the cases where epilepsy was in question.

Migraine.—Severe migraine is disqualifying for naval service because of the incapacitating nature of its major symptoms (headache, nausea, vomiting, prostration, and visual disturbances). The diagnosis is readily made where a typical history of the above symptoms is elicited. Mild cases are relatively common and are not incompatible with active military duty. In young adults, however, migraine and epilepsy may coexist. It has been our policy, therefore, to run an EEG on all cases of migraine, including those that are mild, whenever there is a history of dizzy spells, fainting attacks, or any paroxysmal disorder that might conceivably be on an epileptic basis. It may be seen by referring to table 3 that an abnormal EEG was

TABLE 3.—*Analysis of 40 cases of migraine*

Value of EEG	EEG diagnosis			Number of cases	Percentage
	Abnormal	Borderline	Normal		
Primary.....	1	0	0	1	2
Secondary.....	13	0	12	25	63
Incidental.....	0	2	12	14	35
Total.....	14 (35%)	2 (5%)	24 (60%)	40	100

obtained in 14 cases or 35 percent of this group. In 26 cases or 65 percent of this group, the EEG was of primary or secondary value.

Post-traumatic syndrome.—A number of recruits are seen in whom there is a past history of severe head injury, often with fractured skull, prolonged periods of unconsciousness, and sequelae. Where the neurological examination reveals no definite signs, and where symptoms are minimized or denied, evaluation of the case is difficult, since

it is known that a number of such cases will develop post-traumatic epilepsy. The EEG may be of assistance under these circumstances. In the 24 on whom an EEG was done, 8 were abnormal (3 of primary (case 6) and 5 of secondary value), 3 were borderline and of incidental value, and 13 were normal (of which 8 were of secondary value and 5 were incidental). The EEG was therefore of clinical value in 67 percent of these cases.

Organic feeble-mindedness.—Occasionally the psychologists see recruits of retarded or borderline intelligence in whom there is considerable scatter in the test scores. Experience has shown that such findings may indicate, among other things, the presence of organic disease of the central nervous system. In 3 of the 14 cases in this group the EEG was abnormal.

Somnambulism and enuresis.—Bed wetting is known to be an occasional epileptic manifestation. Somnambulism has not been sufficiently recognized as possibly of similar etiology. Of 12 cases of somnambulism in which an EEG was done, 5 showed abnormal records. One of these patients also had enuresis. Of 2 other patients with enuresis alone, 1 had an abnormal tracing. These two patients were selected for testing from a large group of enuretics because of vague symptoms that were thought to be of possible epileptic origin.

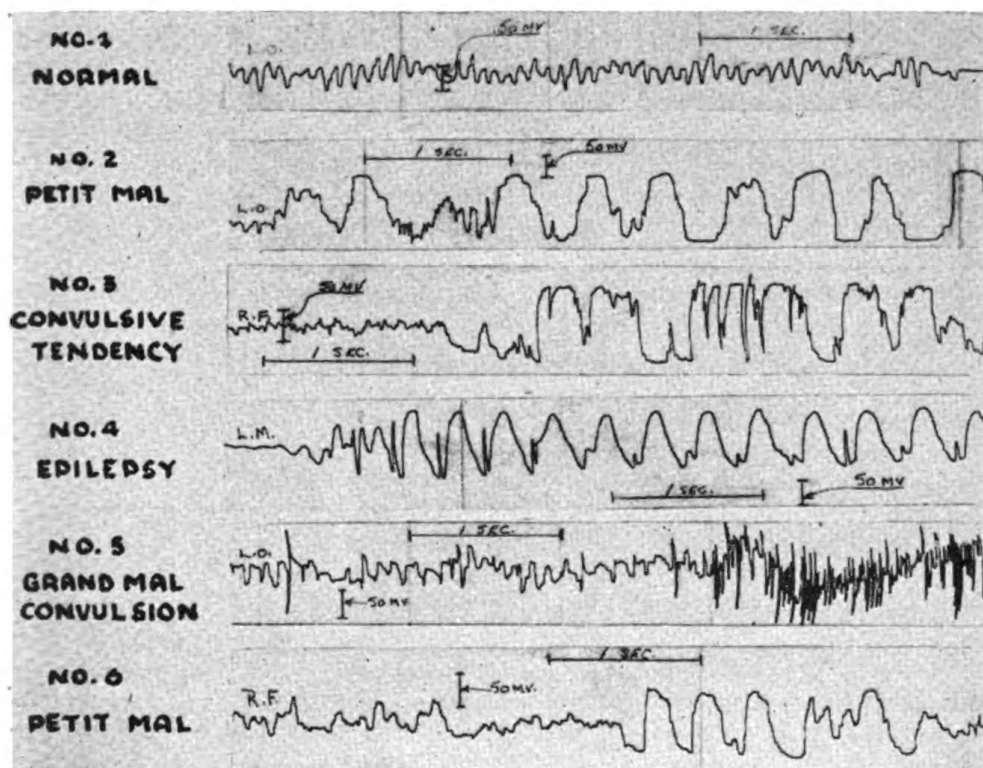
Miscellaneous conditions.—A wide variety of neurological conditions were tested by the EEG. These included multiple sclerosis, brain tumor, electric shock encephalopathy, lead encephalopathy, cerebral hypoplasia, hydrocephalus, postencephalitis and von Recklinghausen's disease. An excellent example of what the EEG may contribute in this type of case is shown in one of the two patients who were tested because of the possibility of cerebral hypoplasia (case 7 and fig. 1, no. 2). This case also illustrates the localizing ability of the EEG. An abnormal record was obtained in one of the two cases of electric shock encephalopathy. In a case of narcolepsy, several sleep attacks occurred during the taking of the EEG. Borderline records were obtained in one of the cases of postencephalitis and in the one case of lead encephalopathy. All the other organic cases showed normal records.

A few psychiatric conditions were tested, but the results were not significant. In two cases of psychopathic personality each showed an abnormal EEG (case 8), but these two were chosen from a large group of psychopaths because of the possibility of some organic involvement.

The EEG may be of value in cases of suspected malingering where the recruit may feign epileptoid symptoms in order to be sent home. More frequently we meet the opposite, "reverse malingering," where the recruit conceals his symptoms and history in order to be retained

in the service. The value of the EEG in such instances is illustrated in cases 9 and 10.

The EEG is not infallible. It presents but one aspect of the total diagnostic picture. It is a laboratory procedure and should be considered as a supplement of, and by no means a substitute for, clinical judgment. Just as the presence of albumin in the urine indicates some disturbance of physiological function in the genito-urinary tract, so an abnormal EEG indicates a dysrhythmia in the electrical discharges of the brain. When associated with appropriate symptoma-



1. TYPICAL ENCEPHALOGRAMS. CALIBRATIONS: VERTICAL LINE REPRESENTS 50 MICROVOLTS; HORIZONTAL LINE REPRESENTS 1 SECOND. L. O. LEFT OCCIPITAL. R. F.—RIGHT FRONTAL. L. M.—LEFT MOTOR.

tology, such a dysrhythmia may properly be regarded as indicative of some disability rendering the subject unfit for military service. The isolated existence of a mild dysrhythmia, however, need not indicate a disqualifying condition.

CASE HISTORIES

Case 1. *Abnormal EEG, primary.*—This 22-year-old recruit was admitted to the psychiatric ward from the recruit examination as a suspected schizophrenic. Subsequent examination showed that the apparently schizoid characteristics were a function of fatigue. However, the recruit gave a history of a convulsion in childhood in association with cervical adenitis, and he seemed mentally dull. He was referred to the psychologist for testing. He tested dull normal, but there was considerable *variability and scatter* in his performance, so that he

was referred to the psychiatrist for further study. An EEG was done, and definite convulsive patterns appeared in the record (fig. 1, no. 3). The recruit, who otherwise would have been sent to trial duty, was rejected with a diagnosis of convulsive tendency.

Case 2. *Normal EEG, primary.*—This 18-year-old recruit was admitted to the psychiatric ward from recruit examination because of a history of dizzy spells and headaches. During hyperventilation he became "hazy." The neurological examination was negative except for slight digital tremor. The first two psychiatrists who examined the recruit felt that he should be rejected as a possible epileptic, but the third questioned the diagnosis. An EEG was done and was normal. A fourth psychiatrist was asked to see the recruit and he thought him to be within normal limits. The case was reviewed in conference with a fifth psychiatrist, and it was decided to send the recruit to duty. He completed his training period successfully.

Case 3. *Abnormal EEG, secondary.*—This 17-year-old recruit was on the way to the mess hall when he fell unconscious. No good description of the incident could be obtained. He admitted previous "fainting attacks" but made light of them. An EEG showed typical wave and spike patterns (fig. 1, no. 4), and on hyperventilation a clinical attack was observed. The recruit was discharged with a diagnosis of epilepsy.

Case 4. *Abnormal EEG, secondary.*—This 21-year-old recruit was admitted to the psychiatric ward following an episode of dizziness and numbness during which he was conscious but unable to speak. Later he admitted previous attacks of a similar nature. While the EEG was being taken he had a typical mild grand-mal convulsion, observed by a medical officer. The EEG record at the onset of the attack is shown in figure 1, no. 5. He was discharged as epileptic.

Case 5. *Normal EEG, secondary.*—The recruit was referred to the psychiatric unit from the main sickbay, where he had appeared several times complaining of headaches and dizzy spells. On examination he was found to be unstable and neurotic in his make-up. An EEG was done, and when this proved normal, further study established the diagnosis of psychoneurosis-hysteria.

Case 6. *Abnormal EEG, primary.*—This 34-year-old man was admitted to the psychiatric ward because of an extensive scar across the left side and center of his forehead, caused by an injury at the age of 5. A depressed area of the frontal bone could be felt just below it. He alleged that he was free of symptoms of any sort. He had completed 3 years of college. The EEG, however, showed definite petit-mal activity on hyperventilation, and this could be localized to the frontal regions, starting on the left side (fig. 1, no. 6). It was decided that the recruit represented a definite hazard in combat duty, and he was rejected.

Case 7. *Abnormal EEG, secondary.*—This 20-year-old recruit was admitted to the psychiatric ward from the recruit examination because of dysarthria, intention tremor, mental dullness, and emotional instability. His mental age was 11 years, but there was marked scatter in his test scores. Because of further neurological findings and the psychometric picture, a tentative diagnosis of cerebral hypoplasia was made and an EEG ordered. The EEG showed a larval petit-mal attack on hyperventilation, well localized in the left occiput (fig. 1, no. 2).

Case 8. *Abnormal EEG, secondary.*—This 29-year-old recruit was admitted directly from the recruit examination because of his hostile attitude and history of several arrests. He had been classified as 4-F by the Selective Service board because he was drunk when examined. His mental age was 11, and he showed marked scatter in the test scores. He had digital tremor, worse on intention. The EEG was abnormal, and a diagnosis of psychomotor epilepsy was eventually made.

Case 9. *Abnormal EEG, primary.*—This 28-year-old recruit was referred to the psychiatric ward from the main sickbay because of headaches and dizzy spells. The description of the spells was very suggestive of petit-mal attacks, but the recruit was obviously homesick. He said that he had lied and concealed the history of his spells so that he would be admitted to the service; but now he wanted to go back to his wife and child, and was therefore telling the truth. Malingering was suspected, but the EEG showed patterns characteristic of epilepsy, and the recruit was diagnosed as epileptic.

Case 10. *Abnormal EEG, secondary.*—This 20-year-old recruit was in company when instructions arrived from Washington that he be brought before a board of medical survey for consideration as a possible epileptic. It appeared that his sister, objecting to his enlistment, had written claiming that he had epilepsy. The recruit vigorously denied the allegation, explaining that his sister would do anything to get him out of the service. An EEG showed definite larval petit-mal seizures. Confronted with this evidence, the recruit confessed that he had had several convulsions.

SUMMARY

Electroencephalography is being employed at the psychiatric unit of the U. S. Naval Training Station at Newport as an adjunct in the selection of recruits. The EEG results in 432 patients are reported. It is found that the EEG is of primary or secondary value in 63 percent of the cases. The greatest benefit is derived in the diagnosis of epilepsy. The EEG is also of assistance in a wide variety of other conditions. Case studies are presented.

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PRESSURE DRESSINGS IN PREVENTION OF HEMOCONCENTRATION

Experimental evidence indicates that in dogs the use of local elastic pressure in burns lowers the degree of hemo-concentration, as indicated by hematocrit readings, lessening thereby the loss of fluid beneath the burned surfaces. However, the mortality rate was not altered by such treatment.—Lischer, C.; Elman, R.; and Riedel, H.: Experimental burns. *War Med.* 3: 482-483, May 1943.

DETECTION OF MALINGERING THROUGH PSYCHOMETRIC TESTS¹

WILLIAM A. HUNT

Lieutenant Commander H-V(S) U. S. N. R.

and

HARRY J. OLDER

Lieutenant, junior grade H-V(S) U. S. N. R.

In a voluntary organization such as the United States Navy has heretofore always been, the problem of malingering has never been a serious one. One is more apt to meet the "reverse malingerer," who is attempting to conceal his defects in order to get into the service, than the genuine malingerer who attempts to simulate false defects in order to leave the service. Genuine malingerers are occasionally seen, however. Those handled by the psychiatric unit at Newport have been of two types. Occasionally men have attempted to malingering during the original recruit reexamination. These men joined the Navy hoping to receive an inaptitude discharge, thinking that they would thereby become exempted from further military service. More common, but still rare, is the man who decides during his period of recruit training that he does not like the Navy and wishes to get out. Most of the cases which have come to the attention of the psychology department at the Newport Naval Training Station have been men of the latter class. During their period of recruit training they become dissatisfied with the Navy and, having some insight into their educational handicaps, hit upon the possibility of magnifying these deficiencies and attempting to appear feeble-minded.

Experience has shown us that these malingerers are easily detected on psychometric examination. It is not as easy to appear feeble-minded as the layman might believe. The habits of thought of the feeble-minded show typical characteristics which can be relatively easily recognized by anyone with clinical experience in dealing with mental defectives. A malingerer attempting to appear feeble-minded does "act dumb" and makes mistakes, but the dumbness is not the dumbness nor are the mistakes the mistakes which are typical of true feeble-mindedness.

It is probable that the restriction on the use of volunteers and the drafting of recruits will make malingering a more important problem in the Navy. It was therefore decided to investigate this ques-

¹ Received for publication February 15, 1943.

tion objectively by experimental means. In order to do this 3 brief tests included in the routine psychometric battery which is used in the recruit reexamination at Newport were given to 2 selected groups of 45 subjects each. One group consisted of feeble-minded individuals drawn from the run-of-the-mill cases. The other group consisted of normal individuals who were told to simulate malingering by attempting to appear feeble-minded. These "malingerers" were given the following instructions:

I am going to give you some brief intelligence tests. You are to pretend that you are a recruit who wishes to be discharged from the service and is malingering by attempting to appear feeble-minded. Therefore, you will try to answer the questions in the way that you believe a mentally deficient person would—you are trying to appear feeble-minded.

No attempt was made to control the intelligence of the group of "malingerers," except that no feeble-minded or border-line individuals were included in this group. The average mental age of the group of feeble-minded was 9.7 years with a range from 9 to 10 years.

The three tests used were Arithmetical Reasoning, Easy Directions, and the 1941 revision of the Kent Emergency. The first two tests have a 2-minute time limit and the third is given without a time limit. Arithmetical Reasoning consists of 10 arithmetic problems; Easy Directions contains 20 simple tasks to be carried out on the test paper by the subject, and the Kent Emergency consists of 10 questions which are answered verbally. Arithmetical Reasoning and the revised Emergency Test have been published elsewhere by Grace Kent.² The Easy Directions Test is also a product of Dr. Kent but is not available for circulation. It is her Directions 33, which has been superseded by an improved form. These tests are not group tests but are administered individually. The results of the experiment will be analyzed both according to quantitative and qualitative differences appearing in the responses of the two groups.

TABLE 1.—*Differences (with critical ratio) in average score and number of items answered for malingerers and feeble-minded*

	ARITHMETIC		EASY DIRECTIONS		E. G. Y.
	Mean score	Average no. items answered	Mean score	Average no. items answered	Mean score
Malingerers.....	2.3	6.2	13.5	12.3	19.8
Feeble-minded.....	1.5	3.4	10.0	8.4	17.6
Difference.....	.8	2.8	3.5	3.9	2.2
Critical ratio.....	2.4	6.6	2.5	5.5	1.8

² Kent, G. H.: Emergency battery of 1-minute tests. J. Psychol. 13: 141-164, 1942.

The quantitative differences appear in table 1. The mean score for each group, the total number of items answered whether correctly or incorrectly, the differences between the two groups, and the critical ratios of these differences are shown. It is immediately apparent that the malingerers get a higher mean score than the feeble-minded. The critical ratios indicate that there is roughly only one chance in a hundred that each of these differences is not significant. The difference in the scores attained indicates that although the malingerers are able to conceal their true mental age on these tests, they do not succeed in getting down to the real level of the feeble-minded. They "act dumb" but not "dumb" enough. A more significant difference appears if we examine the total number of items each group answered irrespective of whether they were answered correctly or incorrectly. Statistically, there is less than one chance in a million that these differences could be produced by chance. This means that our malingerers try more items and make more mistakes. The malingerer evidently thinks of a feeble-minded man as one who does a number of test items, but does them incorrectly. This is not so. It is the malingerer who does a great number of items but does them incorrectly. This difference, as we have said, is highly significant statistically and is the most significant difference in the performance of the two groups.

Tables 2 and 3 show the percentage of each group answering correctly the questions on the Arithmetical Reasoning and Easy Direction tests. These percentages also bear out the tendency of the malingerers to do more. The percentage of successes for the feeble-

TABLE 2.—Percentage of malingerers and feeble-minded passing each item on arithmetic test

Item	Malin- gerers	Feeble- minded	Item	Malin- gerers	Feeble- minded
	<i>Percent</i>	<i>Percent</i>		<i>Percent</i>	<i>Percent</i>
1	44	51	6	24	4
2	27	47	7	7	0
3	42	33	8	11	0
4	27	9	9	9	0
5	29	4	10	9	0

minded drops off sharply in the middle of each test. No feeble-minded man answered correctly the last four items on either test. The malingerers, on the other hand, show a tendency to keep on answering some of the more difficult items correctly. It is impossible to place the results of the Emergency Test in such a diagram, as this test is given without a time limit and the subject is encouraged to give some answer to every question.

The tendency to do more items, and incidentally deliberately to make more mistakes, results in what we call *internal scatter*. Internal

scatter means that the individual's performance level is not consistent throughout the test. We find some of the malingerers failing on easy items but passing more difficult ones. On the other hand, the level of performance of the feeble-minded is consistent. They tend to pass the easy items but not the difficult ones. If we consider quality as representing the level of ability or accomplishment, and productivity the amount attempted irrespective of success, we find quality and productivity closely related in the feeble-minded but not in the malingerers. The malingerer either attempts a great number of items and does only a few correctly, or attempts only a very few items, undertaking some of the more difficult items from the more difficult portions of the test, all of which he does correctly. We may note in passing that this *internal scatter* is also typical of the performance found in various psychopathic states. In other words, we have found that this same type of scatter is valuable not only for detecting malingerers but for distinguishing between dementia and amentia.

TABLE 3.—Percentage of malingerers and feeble-minded passing each item on easy directions

Item	Malln- gerers	Feeble- minded	Item	Malln- gerers	Feeble- minded
	Percent	Percent		Percent	Percent
1	69	51	11	38	9
2	62	38	12	18	7
3	56	18	13	38	7
4	56	33	14	29	4
5	27	69	15	24	4
6	29	20	16	16	2
7	22	56	17	11	0
8	36	53	18	13	0
9	67	62	19	9	0
10	60	56	20	0	0

Certain specific questions demonstrate the inability of the malingerers to duplicate the true performance level of the feeble-minded. Thus, the second question on the Arithmetical Reasoning Test (*If you buy 4 notebooks at 5 cents each and give the clerk a half-dollar, how much change do you get?*) is answered correctly by 47 percent of the feeble-minded group but only 27 percent of the malingerers group. It is obvious that the malingerers tend to overestimate the difficulty of this question. The situation is reversed on questions 4, 5, and 6. (4. *If 8 boys club together and pay \$2 for the use of a room, how much should each pay?* 5. *A boat has 50 staterooms, each having 2 berths. If 80 berths are taken, how many berths are left unused?* 6. *If a single trip costs \$1.50 and a round trip \$2.50, how much is saved by taking a round trip ticket instead of two singles?*) On these questions the feeble-minded seldom succeeded, but about 25 percent of the malingerers answered correctly. On the Easy Directions Test the second direction (*Cross out the shortest word in this line*) is passed by

68 percent of the malingerers but only 38 percent of the feeble-minded. The malingerers underestimate the difficulty of this question. This is particularly true of number 3 (*If D comes after C in the alphabet, draw a square at the end of this line:*). Here 56 percent of the malingerers answered correctly as contrasted with only 18 percent of the feeble-minded. The reverse tendency is shown in number 5 (*Draw a line under the name of a flower: rabbit rose radish*). Here 69 percent of the feeble-minded succeed as compared with only 27 percent of the malingerers. The malingerers overestimate the difficulty of the task.

This failure of the malingerer to duplicate the typical feeble-minded response is seen again when we examine those answers where both groups agree. Even here we find that in many cases the successful answer of the malingerer differs from the successful answer of the feeble-minded, and the mistakes of one group are not the same as the mistakes of the other. For this qualitative analysis, we will refer to some of the answers obtained on the Kent Emergency Test. The first question, "*What are houses made of?*" is easy for both groups, but we find the feeble-minded sticking to conventional materials such as wood, brick, cement, and stone while the malingerers frequently bring in such materials as mud, grass, and clay, which reveal a geographical sophistication not typical of the mental deficient. "*What is sand used for?*" is a question that is also relatively easy for both groups. For some reason, however, the answer "beaches" or "to play in" is not given very often by the feeble-minded, but is found frequently in the responses of the malingerers. The fourth question, "*Tell me the names of some fishes,*" is an easy one, but the feeble-minded answers include more colloquialisms such as "minnies" and "shiners." The malingerers often show a tendency to name slightly unusual fish such as sailfish, flying-fish, or porpoise. The sixth question on the Kent Test is "*Give the names of some large cities.*" The most common feeble-minded answer here is to include the name of one or more States, Pennsylvania being the most frequent. Not a single malingerer included a State in his list. On the tenth question, "*How many stripes in the flag?*" the most common feeble-minded mistake is 48. In fact this response is so common from the feeble-minded that the test instructions include directions to permit the subject to correct this mistake. Again not one of the malingerers made this response.

One final differentiation that may be mentioned, and it is one that would be expected, is the appearance of an occasional bizarre response among the replies of the malingerers. Thus, in the question on fishes, three subjects included the names of birds. In answer to "*What time of day is your shadow the shortest?*" one subject replied, "When you are in the house." Another man giving an answer

to the question, "*Why does the moon look larger than the stars?*" replied, "Because there is a man's image in it."

The results of this experiment demonstrate clearly that the feeble-minded man and the malingerer differ in their responses on a psychometric test, and that these differences have statistical reliability. This article, however, should not be interpreted as offering a specific scoring stencil for the detection of malingering. Such perfect objectivity is impossible at the present time. The individual response patterns are too varied. We have merely demonstrated that there are typical feeble-minded responses that can be recognized by any individual who has had clinical experience in the use of tests with a feeble-minded group, and that malingerers are unable to duplicate these responses. The final judgment by which the malingerers are recognized as such is, after all, a clinical judgment in which the clinician must integrate a number of specific responses into a meaningful total pattern on the basis of which the final decision is made.



GERMAN MEASLES

The principal interest attached to German measles is the diagnosis, and especially, the differential diagnosis from measles and scarlet fever. German measles is characterized by its extreme mildness, the rapidity with which the rash develops, and the absence of complications. It is distinct from true measles by absence of a prolonged prodromal period, absence of Koplik spots, and by the presence of enlarged posterior cervical glands. Scarlet fever usually has its onset explosively with high temperature, vomiting, and severe sore throat, followed in 24 hours by a punctate, erythematous rash, which is never blotchy as in German measles.

While German measles is considered comparatively benign disease with no fatalities, a similar outbreak in England within the last 2 years was accompanied in some instances by alarming complications, such as encephalitis and purpura eruptions. There has been no indication in New York City that the disease is of this type.

A point worthy of note in the cases now being reported is the unusually high proportion of young adults affected. Thus out of 200 consecutive cases reported during March, 19 were in children under 5 years of age, 65 in children 5 to 14, 36 in persons 15 to 19 and 80 in persons 20 years or over.

On the other hand physicians are encountering an unusual number of cases of German measles (*rubella*; *Rötheln*). In the first 3 months of the current year 4,300 cases of German measles, and only 3,300 cases of true measles, were reported. Never before have the Health Department's records shown more reported cases of German measles than of measles.—Department of Health, City of New York.: Unusually high incidence of German measles. Quart. Bull. 11: 17-18, May 1943.

THE MANAGEMENT OF NAVY PERSONNEL WITH RHEUMATIC FEVER. II^{1 2}

ALVIN F. COBURN

Lieutenant Commander (MC) U. S. N. R.

Seventy-three enlisted men comprise the group observed in this study. Sixty-five were acutely ill with rheumatic fever and 8 had quiescent rheumatic heart disease. All but one were under 30 years, and half of this group were below 21 years of age. About 80 percent of the group had less than 1 year of service. Seven patients had a familial history of rheumatic fever. Eight had rheumatic fever during childhood and 6 had experienced growing pains or severe epistaxis, suggesting subclinical rheumatic activity. Five patients had severe rheumatic heart disease prior to enlistment. Fourteen of the entire group had contracted frequent sore throats and 36 patients had tonsillectomies during childhood. Most of the patients came from rural districts, scattered over the country as illustrated in figure 1.

Ten of these 73 patients had either a history prior to enlistment or physical signs of rheumatic fever; they came from metropolitan centers of northern States. The majority of those without a past history or signs of rheumatic heart disease came either from States where rheumatic fever is uncommon or from isolated districts where exposure to respiratory pathogens is limited. Most of these patients developed rheumatic fever during the spring months of their first year in the United States naval service.

Clinical characteristics.—The types of attacks seen in these 65 patients with rheumatic fever were similar to those seen in young adults in civilian hospitals. Pain in a joint of the lower extremity was the initial symptom in the majority and the onset was usually precipitous, often occurring while the patient was at rest. The distribution of pain was: Knee 11, foot 11, multiple joints 10, ankle 9, chest 5, abdomen 4, hip 3, wrist 2, elbow 2, and spine 1. Of the other 7 patients the presenting complaint was epistaxis 4, erythema marginatum 1, fever 1, and tachycardia 1. In degree of severity the patients were divided as follows: 30 mild, 23 moderate, 10 marked, and 1 fulminating. Half of this group had polycyclic attacks; the other half had either severe or mild monocyclic attacks. Polyarthritides and carditis were conspicuous manifestations. Other rheumatic phenomena observed were:

¹ Received for publication December 22, 1942.

² This is the second of three articles by Dr. Coburn on aspects of rheumatic fever. Bibliography and comment will follow the closing article.—*Editor*.

Severe epistaxis in 5 patients, erythema marginatum in 5, subcutaneous nodules in 2, pericarditis in 2, pulmonary solidification in 1 and chorea in 1. One of the patients with epistaxis required 7 transfusions, and the patient with pulmonary involvement experienced a fulminating attack which presented extremely difficult therapeutic problems.



1. THE DISTRIBUTION OF DOTS, EACH REPRESENTING THE HOME OF ONE PATIENT, SHOWS THAT A FAIR SCATTERING OF THESE MEN CAME FROM THE WEST AND SOUTH.

The erythrocyte sedimentation rate was elevated in all 65 patients, rising rapidly during the first week and falling with the subsidence of symptoms. Seventeen patients had a prolonged conduction time (PR interval between 0.20 and 0.44 second) during the first week of the attack with return to normal as carditis subsided. The cardiac measurements, as determined by x-ray, showed increase in only 4 patients and only in the 2 patients with pericarditis did the enlargement persist. In general, the clinical and laboratory findings were similar to those seen among young adults in civilian hospitals.

THE CARE OF THE PATIENT

It has long been recognized that a patient with rheumatic fever requires at least 6 weeks bed rest. Further bed care is indicated for at least 3 weeks after the rheumatic process appears quiescent so far as can be determined by freedom from clinical symptoms, normal pulse rate, and normal blood sedimentation rate. Physical activity should be limited during convalescence to a degree which does not cause tachycardia. Convalescence for at least 1 month should be provided away from the hospital wards and preferably in an institu-

tion appropriately situated for rendering convalescent care free from exposure to respiratory infection. Under conditions of a *war emergency* ideal care is not always available; nevertheless it is possible to protect the patient and the Navy by recognizing rheumatic activity and affording the patient the rest prerequisite to recovery.

The objectives in the ward care of these patients were to prevent death; to minimize the heart muscle damage; and to return as many men as possible to duty with as little loss of time as compatible with their future health. The course of routine care established was divided into four stages:

Stage 1.—As soon as the diagnosis was established the patients were confined to bed and given sodium salicylate 1.6 gm. (25 gr.) with sodium bicarbonate 0.6 gm. every 4 hours day and night. Salicylate therapy was maintained until all clinical signs of rheumatic activity had disappeared and the blood sedimentation rate had remained normal for 2 weeks. Drug therapy was then abruptly discontinued.

Stage 2.—For 1 week the patients were observed closely to detect the effect of salicylate withdrawal. Because of their great dislike for using a bed pan the patients were allowed "head privileges" in a wheel chair during this trial week. If an exacerbation of clinical symptoms was observed or if there was a marked rise in the blood sedimentation rate, the patients were demoted to stage 1 and sodium salicylate administered again for at least 2 weeks.

Stage 3.—When the patients had remained free of clinical and laboratory signs of active disease for 1 to 2 weeks after the withdrawal of salicylate, they were allowed unrestricted "head privileges" and permitted to sit in a chair on the ward or in the sun on an uncovered deck, weather permitting. At this stage recovery was usually progressive; however, the occurrence of an exacerbation in rare instances required demotion to stage 1.

Stage 4.—When the patients appeared free of active disease for 4 weeks they were given light ward detail for 2 weeks. If there was no marked rise in the pulse rate, they were then allowed to return home for 2 weeks, advised to engage in normal activities but avoid severe physical strain. On return from leave they were rechecked. If free of symptoms, maintaining a normal pulse rate and without valvular disease they were considered fit for duty after 1 week's observation.

The 2 weeks' leave proved most helpful to the morale of these men who had been hospitalized for a long period of time. No patients were allowed liberty. An hour's rest at noon was instituted. In selected patients tonsillectomies were performed.

Sulfonamides contraindicated in rheumatic fever.—Sulfonamides exert a peculiar and perhaps unique untoward effect on the rheumatic process. This appears contradictory, since rheumatic fever is believed to be a post-streptococcal disease and since these chemotherapeutic agents exert a beneficial effect on patients with many types of streptococcal infections. However, the important fact, often unrecognized, is that the disease mechanisms are different. In streptococcal infections the cell injury is directly associated with the organism or its products; whereas in rheumatic fever, as has been pointed out, cell injury seems to be associated with a peculiar type of sensitiza-

tion. The effect of the sulfonamides on rheumatic subjects under various conditions may be summarized briefly as follows:

(1) In quiescent rheumatic subjects sulfonamides serve as prophylactic agents against streptococcal respiratory infections (31) with the same effectiveness as against wound infections in general. The patient escapes rheumatic fever because he escapes hemolytic streptococcal infection.

(2) In quiescent rheumatic subjects with severe streptococcal infections, the sulfonamides usually afford prompt relief from the acute disease and may even be lifesaving in bacteremia.

(3) In quiescent rheumatic subjects with mild streptococcal nasopharyngitis the sulfonamides have little or no effect on the acute illness and do not prevent the development of rheumatic fever (32). The reason is believed to be that the drugs are administered after the infection is established and after antigens have been liberated and the rheumatic mechanism initiated.

(4) In active rheumatism, the sulfonamides intensify the degree of activity (33). Existing symptoms are aggravated and fulminating rheumatic manifestation may appear in an individual with a mild attack. The reason for this is still unknown. There is no evidence that it is due to bactericidal action on a subclinical infection. It is recognized, however, that these chemotherapeutic agents modify cellular metabolism, probably by interrupting enzymic processes. It has also been shown that sulfonamides attach themselves to plasma proteins (34), that they act as sensitizing agents (35) and that they give rise to erythema nodosum and arterial lesions (36). An explanation of the peculiar effect exerted by these chemotherapeutic agents on the rheumatic process must await further experimental work.

One more observation which has been made by the author (37) on more than 30 occasions is that individuals may develop their first rheumatic attack during middle life following a streptococcal throat infection which has been treated with a sulfonamide. There is no way at present to determine whether the sulfonamide plays a role in these initial rheumatic attacks. However, the fact that these individuals previously contracted streptococcal infections and escaped rheumatic manifestations favors the possibility that the presence of a sulfonamide in a host infected with streptococcus may tip the cellular balance in favor of the development of the rheumatic mechanism. It was therefore of interest to determine whether any of the present group had been treated with a sulfonamide.

All but 7 of the 65 patients with active disease developed their initial rheumatic attack in the United States naval service. The simplest explanation for this was that these individuals had not been exposed to infection in their home environment and contracted a hemolytic streptococcal disease at a naval activity. Most of these patients were treated at other activities for their respiratory diseases and it is not known how many received a chemotherapeutic agent. It had been established, however, that 12 patients were treated during a throat infection with sulfonamides. Seven received sulfanilamide, 3 sulfadiazine and 2 sulfathiazole. That 2 patients who had lived in environments where rheumatic fever is prevalent,

had contracted throat infections but had escaped rheumatic fever will serve to illustrate this point.

Patient C.—This 21-year old signalman, second class, was admitted with scarlet fever. He had lived in a large city in the Middle West where both his family and he had escaped rheumatic fever. Because of throat infections in childhood the tonsils had been removed. During the first 10 days of scarlet fever he received sulfadiazine (total dosage 48 gm.). Two weeks later he developed a tachycardia, mild joint pains, an elevated sedimentation rate and a prolonged conduction time. The electrocardiographic tracings which had previously been normal, showed a PR interval of 0.28 second. On bed rest and salicylate therapy, symptoms and signs subsided and the conduction system changes slowly disappeared.

Patient D.—This 43-year-old yeoman was admitted with rheumatic fever. He had lived in a large New England town where one brother had manifested rheumatic fever. The patient had had occasional sore throat but escaped symptoms and signs of rheumatic disease. Two months after being called to active duty, the patient contracted tonsillitis which was treated for 6 days with sulfadiazine. Three weeks later he developed his first attack of rheumatic fever characterized by severe migratory polyarthritis and mild carditis.

In summary, sulfonamides are contraindicated in rheumatic fever, are of no prophylactic value once a throat infection is established, and may possibly modify the host in some way which favors the development of the rheumatic mechanism.

Tonsillectomy.—The tonsils were present in 30 of these 65 patients. In some of these the tonsils were not striking; there was no history of frequent respiratory infections, and the rheumatic process subsided satisfactorily. Ten patients either had large ragged tonsils, or had a history of being highly susceptible to respiratory infections or had prolonged rheumatic attacks with mild exacerbations on the resumption of moderate physical activity. For these reasons tonsillectomy seemed advisable after an interval of several months. Because of the difficulty of tonsillectomy occasioned by life at sea it was decided to attempt tonsillectomy before discharge from the hospital. The danger of a severe rheumatic recrudescence was recognized.

The observations of English (38) and American clinicians (39) have shown that salicylates used prophylactically may suppress the development of rheumatic fever. These 10 patients were treated with salicylates, as in stage 1, for 2 days prior to tonsillectomy and for 2 weeks after operation. Each patient developed a moderate rise in the blood sedimentation rate associated with operative trauma. There were no rheumatic exacerbations or electrocardiographic changes and at the end of 2 weeks all blood sedimentation rates were normal. At this time the administration of sodium salicylate was discontinued; the patients were promoted to stage 4 and observed for 1 week at light work before being squared away.

CARE OF THE INJURED HAND ¹

WILLIAM H. REQUARTH
Lieutenant (MC) U. S. N.

There is probably no field of military medicine in which injuries of the hand do not occupy a prominent position. Through the teachings of Kanavel and Koch, these injuries have been elevated to a position of importance in medical practice, sound principles of treatment have been established and surgeons throughout the country have been made to realize that a deeply lacerated hand deserves more than haphazard dispensary surgery. There still exists, however, a great deal of uncertainty in regard to the most efficient management of such injuries, particularly among recent medical graduates, who, though thoroughly acquainted with the technical steps in appendectomy and herniotomy, find themselves completely at a loss when confronted with a serious wound of the hand. It is my purpose to reiterate and emphasize the principles of treatment as applied to the diagnosis and treatment of hand injuries.

For the purpose of discussion, the injuries have been classified as those of the covering tissues, those involving tendons, and those involving the nerves of the hand. The scope of this paper cannot include bone and joint injuries.

GENERAL PRINCIPLES

Of first importance in the treatment of hand injuries is an adequate knowledge of the anatomy of the hand. There are few areas in the body in which are crowded so many vital structures necessary for normal function. A thorough knowledge of anatomy helps one to avoid the embarrassing mistake of uniting nerve to tendon or of injuring other important structures.

In few fields of surgery is primary union of such paramount importance as in the hand. The lack of loose areolar tissue confines even low grade infections around vital structures with disastrous results. Preoperative preparation is an important factor in insuring primary union and should not be relegated to a nurse or enlisted assistant.

A bloodless field is necessary to see clearly and identify the small structures in the hand. To secure it a blood pressure cuff is wrapped smoothly about the upper arm and just before making the incision the extremity is elevated for a full minute; while it is still elevated

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the cuff is inflated to a pressure of 250 millimeters of mercury. The pressure is maintained until all dissection is completed, and tendons and nerves are identified and ready for repair. This may be as long as 2½ to 3 hours. Before releasing the pressure the wound is covered with a moist pressure dressing to check the oozing that results from the compensatory hyperemia. Any active bleeding is controlled with ligatures, the arm elevated again and the cuff reinflated. In our experience such a procedure has never caused damage to the extremity.

General anesthesia is desirable for several reasons. Healing may be impaired and the incidence of infection increased as a result of novocaine infiltration. Many patients cannot tolerate the constriction of the cuff more than 30 minutes. If general anesthesia is not available novocaine infiltration or nerve block must be used.

In order to obtain soft pliable scars, and wounds which heal kindly with a minimum of reaction, careful attention to surgical technic is required. The hand is not a field for the surgeon who wants to "get in and get out." Each structure must be accurately identified and the wound kept moist by frequent saline irrigations. The tissues should be handled with extreme gentleness; the dissection should be sharp and clean with a minimum of tearing. In grasping vessels with hemostats, care must be taken to include only the blood vessel itself and none of the surrounding tissue. Silk is used entirely throughout the operation. For ligatures, the finest grade-A Corticelli white silk can be used. For skin approximation, medium horsehair is best. Much of the success of a difficult tendon repair will depend upon attention to such operative details.

INJURIES TO THE COVERING TISSUE

Simple lacerations.—The presence of tendon and nerve injury is first excluded by careful examination of function. As an aid in determining the possibility of primary union, it is important to establish the exact time and conditions under which the injury was sustained. Wounds less than 4 hours old and not grossly contaminated can usually be converted into clean wounds, but if more time has elapsed primary wound closure should rarely be considered. Proper cleansing of the wound is important. If it is deep and extensive, considerable time and care must be expended. The wound is covered with sterile gauze, the nails cut short and the hand and forearm shaved. The surgeon dons cap and mask, scrubs his own hands, puts on sterile gloves and cleanses the area about the wound with soft cotton wadding and mild white soap. When the part is clean, water and gloves are changed and the wound itself cleansed and thoroughly irrigated with normal saline. Traumatized tissues which do not appear viable or likely to survive

should be excised. No definite rules can be laid down, and good judgment must be exercised. For approximation of subcutaneous tissues fine silk is used. Exact approximation of the skin edges is obtained by interrupted horsehair sutures.

Catgut should not be used in the hand at any time. The reaction produced is not desirable in an area with so little subcutaneous tissue. After closure, a pressure dressing and splint are applied.

Avulsions.—The principle of wound closure must be strictly adhered to in surgery of the hand. Raw areas left uncovered, or lacerations not closed, may cause loss of function of the part. Constantly exposed tendons ultimately become necrotic, act as foreign bodies and are extruded in the same manner as a bone sequestrum. Such a complication may render the entire hand useless. Where there has been actual loss of tissue, the paucity of subcutaneous tissue in the hand prevents a skin approximation without undue tension on the sutures. Frequently a flap of skin and subcutaneous tissue is torn from the surface, and if its base is located distally much of it may be nonviable. If such a flap is sutured in place it may become necrotic and slough. It is sometimes possible to excise the subcutaneous fat from such a flap and replace the skin as a free full thickness graft. If the covering tissue has been severely traumatized it is better judgment to excise it and replace it with some type of graft.

The free full thickness graft is adaptable in many cases; it is whole thickness skin and has enough body to yield a good functional result. It must be carefully cut so that no subcutaneous fat is adherent and its contour must exactly fit the defect. Such a graft is accurately sutured in place with a continuous horsehair suture. A firm pressure dressing is applied with the aid of mechanics' waste or sea sponges and a splint is applied. This dressing is undisturbed for 8 or 10 days and thereafter changed daily; the pressure dressing is maintained for 3 weeks. For good results a surgically clean field and a well vascularized bed are necessary. The graft must not be applied over exposed tendons or bones as these structures do not offer adequate blood supply. If there is doubt concerning the vascularity of the raw surface a graft of intermediate thickness skin should be used. Although a useful and frequently applicable type of graft, its thin caliber makes it less resistant and it is more likely to contract over a flexor surface. The thicker the graft that can be applied with survival, the better will be the result. Extensive areas of uncovered tendon require a covering of subcutaneous tissue as well as skin. A graft which derives its blood supply through one or more pedicles is the only type that can supply both skin and subcutaneous tissue. A typical example of the need for such a graft is when the extensor tendons on the dorsum of the hand have been exposed by avulsion of the skin. In such cases good func-

tional results can be obtained if the hand is placed in a pocket flap over the lower abdominal wall. The scope of this paper does not permit the discussion of technical details of such a procedure. The survival of any graft is dependent on intelligent postoperative care. The dressings must be changed by the surgeon himself and not left to an untrained assistant.

INJURIES TO TENDONS

Accurate diagnosis is essential and should be made by examining the function of the hand rather than by probing the wound.

Flexor tendons.—Primary union is an absolute requirement for good functional results. A wound which is 2 to 3 hours old may be safely considered clean and in wounds sustained indoors and not grossly contaminated the time limit may be extended to 4 hours. Primary repair of crushed wounds and those sustained in the street may be unsafe even after 1 hour. Information obtained in regard to the treatment received between injury and admission to the dispensary is valuable. Ideal first-aid treatment for such injuries consists in covering the wound with sterile gauze and doing nothing further until the hospital is reached. Arterial bleeding is best controlled by a firm pressure dressing or tourniquet and not by hemostats and ligation. If, after weighing all the factors, it is doubtful if primary union can be achieved, it is better judgment to cleanse the wound carefully, close the skin and perform a secondary repair at a later date.

The deep flexor tendons and the flexor pollicis longus are inserted at the base of the distal phalanges and their division can be immediately detected by fixing the middle phalanx and asking the patient to flex the distal phalanx. Inability to do this indicates division of the deep flexor tendons; if flexion is absent at the proximal interphalangeal joint the superficial flexor tendon has likewise been divided. Flexion is retained at the metacarpophalangeal joint through the action of the lumbrical and interosseous muscles. The position of the divided tendon ends may often be predicted. If divided at or distal to the metacarpophalangeal joint with the fist clenched, the distal portion of the divided tendon will be short and far distalward. If such an injury occurs with the fingers extended, the proximal part of the divided tendon may retract as far as the carpal tunnel or even to the wrist.

Bearing these factors in mind, the surgeon must plan his incision to provide adequate exposure and to form a flap which will provide subcutaneous tissue over the line of tendon suture. Occasionally it is feasible to enlarge the laceration in both directions. The incision must not cross the flexion creases of the hand but should be parallel

to or directly over them. Midline incisions over the palmar surface of the fingers invariably result in scar contractures. Transverse incisions in the fingers may be extended proximally and distally along the ulnar or radial aspect of the finger just dorsal to the flexion creases. In searching for tendons in the carpal tunnel or wrist it is advisable to carry the incision proximally in the palm along the thenar flexion crease. The operation should be done under a bloodless field and each digital nerve of the area identified and carefully retracted. Approximation of tendon ends is obtained by a method of suture devised by Mason and Allen (3). If both the flexor digitorum sublimis and profundus are divided, it is advisable to repair only the profundus. The sublimis is excised as far distally and proximally as possible. Such a procedure yields satisfactory functional results and eliminates the impairment of motion which occurs when tendons become adherent in a limited space.

With division of extensor tendons on the dorsum of the hand, where they are not enclosed in a sheath but surrounded by areolar tissue, there is less retraction of tendon ends. The time limit for primary repair may be extended to 4 hours. Good functional results are usually obtained if the wrist and fingers are kept extended for 6 weeks. It is occasionally possible to obtain good results even when no repair is done if complete immobilization in extension is maintained.

After tendon suture the hand must be placed in such a position that minimum tension is put on the suture line. If flexor tendons are involved this necessitates flexion of the wrist as well as the fingers. A dorsal splint maintains this position and a pressure dressing is applied. Large pieces of fluffed gauze are laid between the fingers, in the webs and palm. This is bandaged snugly allowing only the finger tips to protrude.

The healing process of tendon is slow (3). During the first 2 weeks connective tissue is laid down to form a fibrous scar about and between the tendon ends. Recent studies have shown that immediately after operation the suture line will bear a stress of 5 pounds. After suture the holding power of the tendon for the suture rapidly decreases until the fifth postoperative day and rises thereafter. Too early motion after tendon repair results in marked reaction and many adhesions. Complete immobilization is therefore maintained for 2 weeks and then passive motion started. The surgeon who starts motion a few days after operation to prevent fixation of tendons to surrounding structures is actually increasing the possibilities of such an occurrence. The splint is worn until the sixth postoperative week at which time unrestricted active motion may be allowed.

INJURIES TO NERVES

The necessity for accurate diagnosis should be emphasized again; it is only possible by thorough preoperative examination of the function and sensation in the hand. The tactile sensation of the palm and fingers should be carefully examined by means of a pin point and piece of cotton. Additional information is obtained by having the patient oppose the thumb to the little finger, abduct (spread) the fingers and extend the fingers and wrist.

Radial nerve.—Division of this nerve in the upper one-third of the forearm or at a higher level results in the familiar wrist drop plus inability to extend the proximal phalanges of the thumb. There is little sensory impairment due to the numerous anastomotic branches.

Median nerve.—Divisions at the level of the wrist or higher, result in an anesthesia of the radial part of the palm, the index, middle, and radial one-half of the ring finger. Paralysis of the thenar muscles prevents rotation of the thumb to the base of the little finger. Injuries at higher levels in the forearm produce a paralysis of the flexor group of muscles in the forearm. In old untreated median nerve palsies the skin of the palm is shiny and atrophic, the thenar eminence flattened and the thumb lies against the palm where it has been pulled by the unopposed adductors.

Ulnar nerve.—Paralysis of all the interossei, adductors of the thumb, and two medial lumbrical muscles prevents abduction of the fingers from the midline and adduction of the thumb. The sensory impairment is characteristic and involves the ulnar one-third of the palm, the fifth finger and ulnar one-half of the fourth finger. After several weeks untreated cases develop a hyperextension at the metacarpophalangeal joints, due to the unopposed action of the extensors. This produces the classical clawhand.

Return of function depends on the growth of axons into the distal trunk. To make this possible the nerve ends must be accurately apposed with interrupted sutures of fine black silk. These include only the nerve sheath; care must be taken not to place sutures in the nerve bundles or allow blood clots to interpose between the ends. Since each trunk is made up of many small bundles it is important that no rotation occur between the trunks. This can be prevented by placing sutures in the sheath before normal relationship is disturbed (4).

The hand is then placed on a splint which will prevent tension on sutured nerve ends and support the paralyzed muscles in a position of physiologic rest. It is essential that the paralyzed muscles should not be overstretched by the action of unopposed antagonists. The splint must be worn until nerve regeneration has occurred, a period varying from 9 to 12 months.

Radial nerve division requires a splint which will hold the wrist in dorsiflexion and the thumb extended and abducted from the hand. The paralyzed thenar muscles in median nerve injuries are relaxed by wearing a wristlet with strap attached which rotates the thumb to the ulnar side of the palm. Hyperextension of the proximal phalanges in ulnar nerve palsies is prevented by placing a light splint on the dorsum of the hand to hold the proximal phalanges slightly flexed.

SUMMARY

Injuries involving the nerves, tendons, and covering tissues of the hand have been discussed. The principles and details of treatment have been outlined with emphasis on correct diagnosis, proper pre-operative preparation, and meticulous attention to surgical technic.

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ORTHOSTATIC ALBUMINURIA AND RECRUITS

It is evident that among the young men of this country there are a considerable number of cases of orthostatic albuminuria and that many have been rejected by medical examining boards because of the presence of albumin in the urine.

Before a diagnosis of orthostatic albuminuria is made, the following criteria should be met: (1) No past history of renal disease; (2) normal blood chemistry, non-protein-nitrogen, blood urea, total protein and albuminglobulin ratio; (3) normal kidney function (phthalein, urea clearance, and dilution and concentration tests); (4) no white-blood cells, red-blood cells or casts in the urine, except intermittently and in small numbers; (5) no elevation of the blood pressure; (6) negative plain X-rays and intravenous urograms; (7) absence of albumin in the urine secreted and voided when in the recumbent position.—Young, H. H.; Haines, J. S.; and Prince, C. L.: Orthostatic albuminuria: The importance of its recognition by medical examining boards. *Mil. Surgeon* 92: April 1943.

INJURIES OF THE SEMILUNAR CARTILAGES OF THE KNEE ¹

THOMAS H. PETERSON

Commander (MC) U. S. N. R.

and

JOHN J. LILLE

Lieutenant Commander (MC) U. S. N. R.

It is our aim to demonstrate the diagnosis and treatment of meniscal derangements of the knee. In the Navy we have some difficulty in evaluating the history, since the element of malingering must be ruled out. Some men want to avoid sea duty and would even undergo an arthrotomy to remain ashore.

In our series of 40 operated cases during the calendar years 1941 and 1942, we have made an attempt to correlate the history, physical findings, and pathology. X-ray was only of aid in the cases of osteochondritis dissecans.

All gave a history of twisting, pain, and swelling of the knee. A definite story of locking was present in 22. The remainder described their sensations as a weakness, "giving away," or "buckling of the knee." The ages varied from 19 to 57 years; usually occurring in the 20- to 30-year-old-group. The complaints dated anywhere from 2 days to 3 years, with 2 to 12 episodes of recurrent attacks.

The physical findings were tenderness over the tibial condyles, flexion deformity, and effusion into the knee-joint. Either 1 or a combination of any of the above 3 signs were present. The medial meniscus was involved 36 times in contrast to 4 lateral menisci, that is, a ratio of 9 to 1. There was 1 bilateral case. The right knee was the seat of pathology in 24 of the patients, as of 16 in the left knee; that is a ratio of 3 to 2.

Operation revealed some increase in the synovial fluid varying in amount according to the time of the last attack. The contents were serous to serosanguineous and usually of a thin to a viscous consistency. There were 12 detached or loose cartilages, 14 torn cartilages, 5 bucket-handle tears, 5 longitudinal tears, 1 eroded cartilage, 1 cartilage with attached small firm yellowish bodies, 1 incompletely removed cartilage, and 1 intact cartilage. The latter was not removed.

There were five cases of osteochondritis dissecans. In this group two were associated with anterior cruciate ligament tears and another with a torn internal lateral ligament.

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One joint revealed arthritic changes with an eroded cartilage. There was a multiplicity of findings in two other joints. The first showed a combination of a torn internal lateral ligament and a detached internal cartilage. The second demonstrated a torn internal lateral ligament and an anterior cruciate ligament with a posterior displaced internal cartilage.

The two cases with bizarre findings were rather interesting. One showed a heavy fibrous band, yellow in color running from the lateral intercondylar notch to the anterior insertion of the medial cartilage. Incidentally, the latter cartilage was the one that was not removed. Histologic sections demonstrated the band to consist of fat cells. The remaining case had multiple firm yellowish bodies attached to the anterior portion of the external cartilage. The histology of these bodies was not ascertained.

In regard to our operative technic we are now removing our cartilages completely in the following manner. A lunar skin incision about 2 inches in length is made from the femoral condyle to below the tibial condyle on the lateral or medial aspect of the knee with the convexity pointing to the patella.

The greatest curvature is one finger's breadth away from the patella. The capsule and the synovial membrane are opened in a longitudinal manner above the internal or external lateral ligaments. After the cartilage is loosened anteriorly and at the sides, it is passed through another longitudinal incision in the capsule and synovial membrane below the ligament. The cartilage is placed under tension and the posterior portion is finally detached from the tibia. Both openings in the synovial membrane and capsule are closed with cotton, the subcutaneous tissue with catgut No. 0, and the skin with cotton. One to 2 grams of sulfanilamide powder are instilled between the layers of the wound. On the ward sulfathiazole is given orally for 5 days.

The cruciate ligament tears were not repaired.

Postoperatively, an elastic bandage was applied to the knee, lower thigh, and leg. Quadriceps drill along with raising of the extended knee was begun within 24 hours. The patient was permitted out of bed on the fifth day, which was usually after 48 hours with a flat temperature. A gradual increase of weight bearing was encouraged. Sutures were removed on the eighth to the tenth day. This was followed by whirlpool, baking and massage, and quadriceps exercise. The quadriceps exercises were stressed very much. They were accomplished by active contraction of the muscle and by the use of the bicycle and rowing machines.

There were no wound infections.

The average stay in the hospital of the uncomplicated cases was 40 days. Those associated with ruptured internal collateral ligaments remained in the hospital 120 days.

Upon discharge to duty, all had complete extension of the knee, with a minimum of 90° flexion, and a minimum amount of swelling of the knee joint. The men with the nonrepaired cruciate tears had good stable, weight-bearing joints.

CONCLUSIONS

1. Forty cases of internal derangements of the knee have been discussed.
2. The diagnosis must be made from the combination of the history and the physical findings.
3. Recurrences of knee disability was our criterion for arthrotomy.
4. Repair of the torn anterior cruciate ligaments was not necessary in the presence of intact external and internal collateral ligaments.
5. Another approach for a complete removal of the meniscus was presented.
6. We feel that quadriceps postoperative exercise was the most important factor in the strengthening of the knee joint.

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ETHER MASK FOR USE IN THE TROPICS

It is well known that it is difficult and wasteful to administer ether by the open drop method in the tropics. We have frequently had to use six or more cans of ether for an anesthetic lasting less than an hour. Surgical anesthesia was maintained with some difficulty. No closed type mask is issued in field units.

We have found the home made mask to be described to be entirely satisfactory. The felt covering from a dust respirator is removed. The valve flap and all the spokes except the two in the vertical plane are removed from both the inhalation and exhalation openings. A four by four flat is folded and secured to the inside of mask by a thread tied over the remaining spokes. The mask is worn in the usual manner and ether is slowly dripped through the openings. Usually one can of ether is adequate. Induction is short and the patient is easily maintained in the desired plane of anesthesia. The mask fits tightly around the nose and prevents irritation of the eyes by ether.—Report to Bumed. Lt. Comdr. F. G. Thompson (MC) U. S. N. R., and Lt. C. O. Terrell, Jr. (MC) U. S. N.

OCULAR PATHOLOGY IN VARIOUS TYPES OF DIETARY DEFICIENCIES WITH PARTICULAR EMPHASIS ON ARTERIOLAR SCLEROSIS¹

AN EXPERIMENTAL STUDY

ARTHUR ALEXANDER KNAPP

Commander (MC) U. S. N. R.

and

SOLON N. BLACKBERG, M. D.²

In previous reports^{3,4}, we have demonstrated the effects of lack of vitamin D and disturbances of calcium-phosphorus metabolism in the eye. The results obtained with a deficiency of vitamin D prompted us to study the ocular pathology due to depletion of some of the other vitamins. The present investigation was conducted to determine particularly whether the fundal changes described in our previous report were specifically caused by the lack of vitamin D and the disturbed mineral metabolism, or whether they might be secondary to general, non-specific malnutrition.

Eighty-eight adult rats were divided into four groups. As far as possible, litter mates were equally divided among the groups with a similar distribution of males and females. Group 1 received a normal, adequate, and complete diet and served as a control during this study. Group 2 received an adequate supply of all of the vitamins and minerals to support normal growth and maintain good health but their caloric intake was reduced sufficiently to cause a loss of body weight. This was done to determine whether the pathology in the eye was caused by either a lack of the specific vitamin or general inanition, or both. Group 3 was fed a diet lacking vitamin A but adequate in all other respects. Group 4 received a diet lacking vitamin B complex. These diets were given for 6 months, during which time repeated weekly examinations of the eyes were made to study both the external and internal pathology. An accurate record of the weight of each rat was recorded and is presented in chart 1.

External ocular examination of the rat is, of course, a simple procedure. However, the rat's pupil is so small (less than 1 mm. in diam-

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² Nutrition Research Laboratories, Chicago, Ill.

³ Blackberg, S. N., and Knapp, A. A.: Ocular changes accompanying disturbances of calcium-phosphorus metabolism; preliminary study. *Arch. Ophth.* 11: 665-669, April 1934.

⁴ Blackberg, S. N., and Knapp, A. A.: Influence of vitamin-D—calcium-phosphorus complex in production of ocular pathology; histological study of changes in fibrous tunic. *Am. J. Ophth.* 20: 405-407, April 1937.

eter in ophthalmoscopic light) that it precludes fundus examination without a mydriatic. For this purpose, a conjunctival instillation of 1 percent atropine sulfate or 2 percent homatropine hydrobromide is used. A sufficiently dilated pupil is produced to permit detailed fundus examination. The disc is best viewed with the light directed from the inferonasal quadrant, using approximately a plus-10 lens. Not all of the animals, including the controls, have distinct fundi. With some effort, however, sufficient detail can be brought out. The disc, generally, is indistinct and not well outlined. It has a small

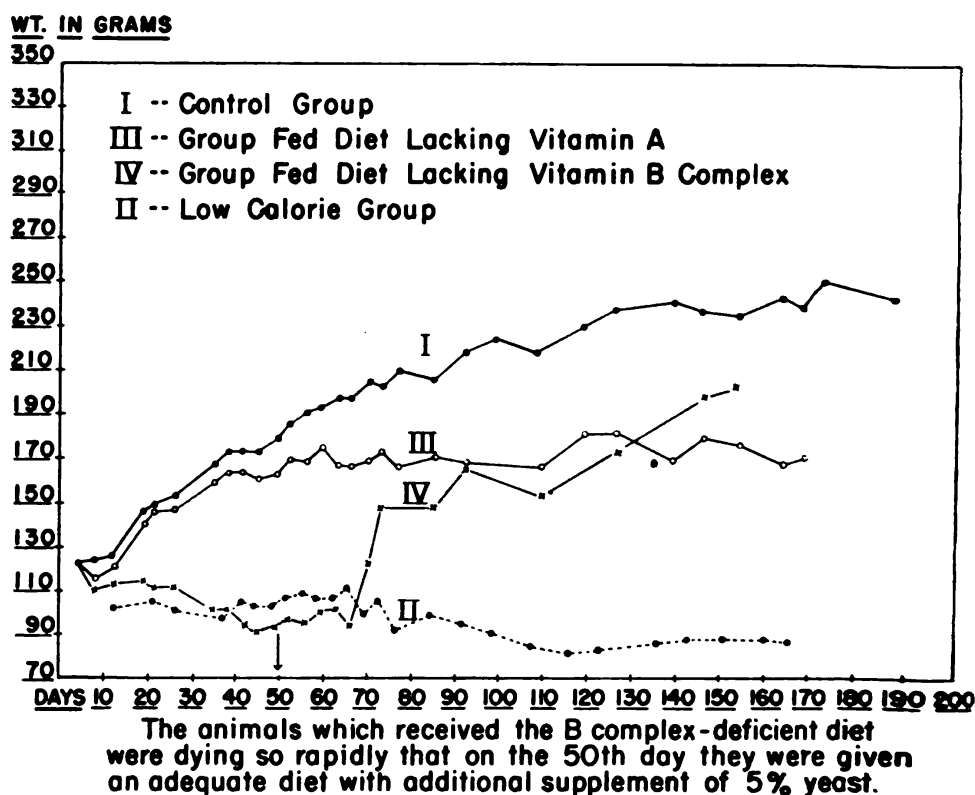


CHART 1.—Weight changes in rats on four controlled diets

physiological cup. Emerging from it are 11 to 14 vessels. These vessels run a comparatively straight course, seldom branching except in the extreme periphery. Therefore, arteriovenous crossing is seen only occasionally. The relationship in caliber, arteriole to venule, is the same as in man, being 2:3. The even, diffuse color of the background of the fundus oculi varies with the pigment of the animal. The albino fundus is a bright yellow-white. As the depth of pigment of the body of the rat increases, the fundus shows a darker hue.

Group 1—Adequate control diet.—In group 1 there were 22 adult rats who received a normal, adequate, and complete diet. They served as controls. Their diet consisted of:

	Percent
Starch.....	59
Casein.....	20
Wesson oil.....	6
McCollum's mineral mixture.....	4
Agar.....	2
Irradiated yeast.....	5
Cod liver oil.....	4

Their eyes were essentially normal throughout the course of this study. No consistent external or internal pathology could be seen. In the fundi of two of the old rats, however, there were engorged venules and very slightly attenuated arterioles.

Group 2—Deficient in total calories.—Group 2 consisted of 22 adult rats. They were fed a diet completely adequate from a qualitative standpoint but inadequate in caloric value. Since the total amount of food furnished each rat was limited, supplements of the vitamins and minerals were administered so that each animal received the same amount of each of these essential components per 100 gm. of body weight as the animals receiving an optimum diet. In this manner, it was possible to rule out any vitamin deficiency as a cause of the ocular pathology produced. In the first 2 months of this study, incipient lens opacities were seen in the eyes of 8 of the starved rats. Several phases of cataract were observed: Posterior central cortical haze, diffuse cortical haze and vertical bands of lens opacity. There was a central lenticular vacuole in one eye. These opacities did not progress.

During the third month, vascular changes in the fundus became evident; slight venous engorgement, early pallor of the arterioles, increased light reflex when the ophthalmoscopic light beam was focused on the walls of these small arteries. Mild attenuation of the arterioles next was observed. In the fourth month, the optic discs were slightly pale and in 15 of the animals there were white, highly refractile streaks radiating from the papillae. They resembled lines of retinal degeneration and extended from $\frac{1}{2}$ to 4 disc diameters peripherally. Circumpapillary haziness also was present. In the fifth month, the highly refractile streaks showed very occasional coalescence. All of the visible arterioles became more attenuated and more highly refractile. By the early part of the fourth month, the starved animals manifested muddy irides. At the end of the month, 17 of the rats had died and exophthalmos was present in the 5 still living.

Group 3—Deficient in vitamin A.—In Group 3, 22 rats, about 4 months old, were fed a diet deficient in vitamin A but adequate in all other respects. They received the following diet:

	<i>Percent</i>
Starch.....	59
Casein.....	20
Wesson oil.....	10
McCollum's mineral mixture.....	4
Agar.....	2
Yeast.....	5
Cod liver oil.....	—

These animals were examined preexperimentally and were found to be normal. There was no demonstrable ocular pathology.

Late in the first month, however, 7 of these rats showed hazy fundi. Engorgement of the venules was noticed 2 weeks later. Changes in the arterioles soon followed for, early in the third month, the arterioles became pale and manifested an increased light reflex. By the end of that month, the eyes of 9 animals developed slight xerosis of the cornea and, hence, the fundus oculi examination was not satisfactory. But in the others without corneal pathology the fundi were visualized readily. There were pale arterioles with a high light reflex and uniform narrowing, engorged venules and very refractile streaks of yellow-white exudate on the optic discs and radiating from them.

During the second month, external ocular signs of deficiency appeared. Moderate serosanguineous discharge was present on the lid margins of 10 of the animals. This secretion was inspissated and glued the lids together. Early xerosis of the cornea was present in 5 more rats, making a total of 14. In 1 animal, a roughly circular macular opacity of the cornea, 3 mm. in diameter, was observed in the superotemporal quadrant of the right eye. Another animal showed a similar lesion centrally in the left eye. In some cases, the hazy corneas interfered with detailed fundus examination while in others there was seen a circumpapillary, white, highly refractile area. This area of degeneration was formed by coalescence of the multiple streaks radiating from the discs. The papillae showed slight swelling. The arterioles became progressively more attenuated.

In the third month, nine more rats showed a blood-tinged inspissated discharge along the lid margins or at the medial or temporal canthi. Partial disappearance of the cilia was observed, particularly around the lateral canthi. Enophthalmos developed in two animals, although their fundi were similar to the others. The papilledema increased slightly. The circumpapillary area of degeneration in the retina progressed more rapidly by coalescence of the streaks which sometimes almost extended to the periphery of the fundus. Attenuation of the arterioles was present in all and became more pronounced, especially the circumpapillary degeneration. This area now was a solid mass and varied in extent from $\frac{1}{3}$ to 1 disc

diameter peripheral to the papilla. The fundi then became too hazy for definition.

Group 4—Deficient in vitamin B complex.—Group 4 consisted of 22 rats about 4 months old. They were fed a diet deficient in vitamin B complex, but adequate in all other respects. The diet for this group consisted of:

	Percent
Starch.....	64
Casein.....	20
Wesson oil.....	6
McCollum's mineral mixture.....	4
Agar.....	2
Yeast.....	—
Cod liver oil.....	4

Preexperimental examination revealed no internal or external ocular pathology in this group.

After the animals had received the diet for only 1 month, fundus oculi examination revealed definite pathology. Seven of these rats showed hazy discs, pale, highly refractile arterioles and questionable arteriolar narrowing. During the following 2 weeks, 10 more of the animals manifested similar changes. One of the rats developed an enophthalmos. Externally, the eyes of the other rats appeared normal. At no time during the study could lenticular changes, or any other pathology of the media, be made out. After 6 weeks, so few of these animals survived that a comprehensive study of the ocular manifestations could not be made out.

DISCUSSION

Of extreme value to the clinician and, especially to the ophthalmologist, is the observation in this investigation that, with the exception of retarded growth, the eye lesions were the first pathologic features to be observed. The retinal changes were seen early and, as the deficiency progressed, these changes became increasingly severe. There was no pathognomonic fundus lesion in the eye by which any specific deficiency could be identified. The pathologic vascular changes occurring in the groups suffering from various types of deficiency were qualitatively similar but varied in degree of development. The characteristic arteriolar changes found were: Increased light reflex, pallor and uniform attenuation of these vessels along their entire course. Since crossing of the arteriole and venule is rare in the rat, the crossing sign of Gunn, indentation of the venule by the sclerotic arteriole, could not be used as a criterion for sclerosis.

In the human being, comparable ocular pathology is diagnosed as senile arteriolar sclerosis. An early sign of human arteriolar scler-

rosis is increased light reflex. This is followed by pallor and attenuation of the arteriole. The attenuation in the senile type is uniform throughout the length of the vessel, in contradistinction to the intermittent narrowing which is characteristic of the hypertensive type. Both forms, however, may be and often are, coexistent. The striking similarity of these changes occurring during the development of arteriolar sclerosis in man to the fundus pathology observed in the experimental animals leads one to suspect a relationship between malnutrition and vascular disease.

The cause of human arteriolar sclerosis remains a moot point. Many theories have been advanced. Faulty nutrition has been mentioned as a possible or a contributing cause. In this report, we have studied the ocular changes in groups of adult rats on diets deficient in vitamin A, in vitamin B, and in caloric value. In previous papers we have described the fundi of dogs on a vitamin-D deficient diet, observing the ocular lesions during the latent state of their deficiency. All of the animals in these groups manifested significant arteriolar pathology. They revealed changes which clinically paralleled human arteriolar sclerosis of the senile type.

SUMMARY

Lesions resembling senile arteriolar sclerosis in the human were produced in the eyes of rats suffering from various types of malnutrition. Faulty nutrition, irrespective of whether the deficiency was caused by a lack of adequate caloric intake, vitamin A, or vitamin B complex, consistently produced the following vascular changes: Increased light reflex, pallor and uniform attenuation of the arterioles along their entire course. In previous experiments, we have observed that in vitamin D deficiency similar pathology was produced. Thus, the arteriolar sclerosis induced was not specific for any vitamin deficiency but, rather, followed a general nonspecific disturbance of the cellular nutrition.



DIET HABITS

In a recent survey of 4,000 families, it was found that only 15 percent had what the modern nutritionist considers a "good" diet, 25 percent had a "fair," and the remaining 50 percent a "poor." These proportions were nearly the same for all income levels. For the lower income levels this state of affairs, of course, may be due partly to lack of purchasing power; however, for the most part, it is caused by ignorance of proper eating habits and by the present high degree of refinement in the preparation of food.—Wohl, M. G.: Incidence of deficiency diseases protein requirements. A Guide to Practical Nutrition. 1-4, Reprinted from Philadelphia Medicine, 1941-42.

LABORATORY AIDS IN THE TREATMENT OF THE SHOCK STATE ¹

HERBERT R. BROWN, JR.
Lieutenant (MC) U. S. N. R.

It is obvious that conditions immediately following battle or other catastrophe allow only fundamental first-aid attention. Many serious casualties will survive and reach bases or hospitals, only to be lost days after the initial injury unless proper and adequate therapy is available and administered. The present report concerns the method and interpretation of simple but invaluable laboratory aids in the treatment of shock.

Too much emphasis cannot be given to the treatment of the collapse or shock state. By prompt evaluation of the patient's status the physician may abbreviate this shock and thereby save life. It should likewise be stressed that each case must be individually considered. What is proper and adequate for one may be excessive or deficient in what appears to be another identical case.

Theories of shock have been recently extensively discussed by Blalock (1), Harkins (2), Moon (3), Scudder (4), and many others. There is, and will be for some time, considerable debate as to the causative factor or factors in shock; however, as evidence has increased, investigators have come to agree that after the shock state has occurred, or even before its onset, the derangement of the circulatory fluids, blood, plasma, or both is the most important factor of all.

The following measurements of the patient's fluid needs are simple and can be easily carried out in any hospital unit which has modest laboratory apparatus. Various determinations are made periodically, much as one plots the course of a diabetic patient with the aid of laboratory procedures. These may be necessary as often as every 4 to 6 hours, as for example in the critical phase of shock or approaching shock in the burn case. Here rapid changes can, and do occur, and a 12-hour or overnight delay in meeting body fluid requirements may be too late. These determinations measure directly the status of the fluid and cellular elements of the circulatory system, and indirectly the fluids in the interstitial spaces.

The following tests are discussed. In all situations it is assumed that the individual prior to the shock state was an adult, normal in all respects.

¹ Received for publication December 21, 1942.

RED BLOOD CELL COUNT

This test when taken alone as an index of the number of red cells in the body is not adequate, for factors in dehydration and overhydration may lead to false interpretations as will be presently shown.

HEMOGLOBIN

The amount of this oxygen-carrying pigment parallels the red cell count in general but for some variations in the blood dyscrasias. Here as in the case of the red cell count the factors of dehydration and overhydration may give false clues as to actual conditions of the circulating blood of the shocked individual.

WHITE BLOOD CELL COUNT

This determination is desirable but not absolutely necessary. An initial count should be made, however, in all cases, for it will serve as a base line in case of future complications. This is extremely important in the burn case. Differential counts of course should periodically be made. Varying degrees of leukocytosis are seen in practically every shock state.

HEMATOCRIT OR CELL PACK

This test requires the transfer of oxalated blood to a hematocrit tube (preferably Wintrobe in type) and then centrifuging at the rate of 3,000 r. p. m. for 30 minutes. This is a particularly valuable test since this centrifuged column of blood is a mirror reflection of the cell volume of the circulating blood as contrasted with the total plasma or fluid fraction of the blood volume. Of course it must be remembered that this specimen is obtained from the peripheral blood and it does not necessarily represent the state of blood in the splanchnic areas in the shock state, where large pools of blood accumulate. If the volume of packed corpuscles is high in shock, it means that there is peripheral concentration regardless of the cause. This may mean fluid or plasma loss or both, but that remains for a further consideration. If the hematocrit reading is low it can mean only one thing—cell loss, and in this situation replacement of red cells is necessary. In some cases of severe shock the hematocrit level seems to be considerably lower than it should be for the corresponding red count; for example a red cell count of 3.8 million and a hematocrit reading of 29 millimeters. This seeming paradox in severe shock states is attributable to a reduction in mean corpuscular volume. The phenomenon has been observed in numerous instances and will be reported at a later date. In such a situation as in the above example the mean corpuscular volume is 78 as compared with normals of 80–94. This situation is apparently only transient.

PLASMA SPECIFIC GRAVITY

The measurement of the specific gravity of the plasma is of great value since it gives one an accurate estimate of the state of hydration of the plasma fraction of the blood itself. The total proteins of the blood may likewise be fairly accurately calculated from this determination, thus contributing to a great saving of time in laboratories already overtaxed by other procedures. The following averages for the various plasma fluid balance ranges are presented. These were obtained from 5,000 determinations of plasma specific gravity by pipette pycnometer method (6) (11). They were made on normal individuals, patients in various stages of shock, as well as routine cases receiving fever therapy.

TABLE 1.—*Plasma specific gravity in health and disease*¹

Classification	Plasma specific gravity	Total protein
High-dehydration.....	1.0290 and over....	7.6.
Normal.....	1.0265 to 1.0290....	6.3 to 7.5.
Low normal.....	1.0235 to 1.0255....	5.6 to 6.3.
Threshold level (edema may occur).....	1.0227 to 1.0235....	5.3 to 5.6.
Overhydration or edema.....	1.0227 and less....	5.3.

¹ Method and data in table 1 from the departments of medicine and radiology, University of Rochester School of Medicine and Dentistry.

The importance of such measurements was initially described by Moore and Van Slyke in 1930 (7), when they revealed that a linear relationship exists between the total proteins and the specific gravity of the plasma. The pycnometer used by them was a small bottle type. In 1926 Barbour and Hamilton (8) described a falling drop apparatus which was especially revised by Kagan in 1938 (9), for routine use by laboratories. The methods for determining these values are: (a) The falling drop apparatus, and (b) The pipette pycnometer method. The latter is simple and merely constitutes the weighing of the plasma-filled pipette. This method will later be completely described.

The plasma proteins, as reflected by the plasma specific gravity, are singularly important in affecting the fluid balance of the body, for they are concerned with the maintenance of circulatory volume by means of their oncotic and osmotic pressures. In severe dehydration, without plasma loss, the plasma specific gravity is elevated and one can foretell the approach of the danger point, for marked circulatory plasma concentration indicates cellular damage and destruction. On the low side of the ledger one either has overhydration or gross edema; overhydration per se is usually only a transient phenomenon. This occurs because the total proteins are incapable of retaining the proper amount of fluid in the circulatory system, and it passes into the interstitial spaces, with the consequent occurrence of imbalance and edema.

TABLE 2.—*Key chart to approximate cell and plasma concentrations in the various shock states*

[All the various determinations in the following table are based on the assumption that the individuals have a normal blood picture in all respects prior to injury].

Type of state	Red cell count (millions)	Hemoglobin (grams)	White cell count	Hematocrit (milli- meters)	Plasma specific gravity
Normals.....	4.5-5.0.....	13.5-15.....	7,000-10,000....	42-47.....	1.0255-1.029
Shock, traumatic without hemorrhage.....	5.5 and over...	15 and over.....	9,000-20,000....	46-60.....	1.0290-1.030
Shock, traumatic with hemorrhage.....	Low, 3.5 or less.	10.0 or less.....	7,000-18,000....	35 or less..	1.0260-1.028
Hemorrhage, severe.....	2.0 or less.....	7.0 or less.....	5,000-16,000....	28 or less..	1.0240-1.028
Burn, severe.....	As high as 9.0.	As high as 21.0..	20,000-30,000....	60-70.....	1.0190, lowest level observed.
Shock, dehydration type ¹ .	5.5-8.0.....	15-20.....	9,000-13,000....	50-60.....	1.0290-1.030
Shock, overhydration type. ¹	3.0-4.0.....	8.0-12.....	7,000-13,000....	25-40.....	1.0180-1.028

¹ These shock states illustrate those that occur in artificial fever therapy, and represent the danger zone of fluid imbalance in this type of treatment. They may also apply to those individuals who have suffered from inadequate fluid intake, such as shipwreck survivors deprived of water for extended periods of time.

Table 2 illustrates very roughly the approximate values which are encountered in the various shock states. It is surprising how clear the picture becomes if data is gathered chronologically, for then the physician in charge need no longer estimate the fluid, blood, or plasma needs of the seriously shocked patient.

The importance of this data is obvious and its interpretation not difficult if one thinks in terms of the previously discussed variables. We have found it expedient to maintain one or more qualified laboratory technicians on watch 24 hours a day, and thus have them available to determine promptly the red cell count, hemoglobin, white cell count, hematocrit, and plasma specific gravity. This is routine on all shock cases. Such measurements are repeated as often as necessary during the critical phase of the case. Through repeated contacts with this work these technicians have become adept at analyzing the laboratory data, and well understand the principles involved. The system has been very successful and any base hospital is equipped to carry out such measures. It may be noted that no electrolyte measurements have been considered. The salt balance is of great importance but NaCl analyses are long and add unnecessary complications and extra work. Shock in most instances can be adequately managed by the afore-mentioned procedures. It must be remembered however that an accurate record of the vital signs together with sound clinical judgment are of paramount importance, and the purpose of this report is to show how the laboratory can be an additional aid to the physician in the management of the patient's fluid needs. Additional tests may be necessary as complications arise and should be employed when they are indicated.

CASE REPORTS

Case 1.—The patient, a 20-year-old male, received severe third-degree burns of both legs and thighs, which represented about 30 percent of his body area. The burns were caused by an unusually hot flame and were deeper than originally anticipated.

TABLE 3.—Laboratory data in case 1

Date	Time	RBC (mill.)	Hb. (gm.)	WBC	Plasma, specific grav.	Hema- tocrit	Blood	Plasma, cc.
Sept. 10	1530	5.0	12.5	22,500	1.0287	40		
Do	2030	5.7	19.2	33,600	1.0256	51		600
Sept. 11	0100	5.94	15.2	22,400	1.0250	52		
Do	1030	6.24		36,000	1.0248	52		1,200
Do	1600	5.3	16.5	32,000	1.0254	51		
Sept. 12	0830	7.9	17.5	25,000	1.0236	53		950
Do	2200	6.3	16.5	30,600		45		
Sept. 13	1000	6.2	16.5	20,500	1.0249	39		260
Sept. 14	0930	4.89	13.0	28,900	1.0250	40		
Sept. 15	0930	7.1	15.5	23,050	1.0245	42		450
Sept. 16	0900	4.29	12.5	18,500	1.0252	38		
Sept. 17	0900	5.16	12.5	21,350	1.0250	37		
Sept. 18	0900	4.33	10.0	19,200	1.0262	33		
Sept. 19	0900	4.63	11.5	37,500	1.0258			
Sept. 20	0900	4.28		22,700	1.0254	31		

This case is of unusual value because the patient was received in the hospital within an hour after receipt of his burn. Consequently, the trend from normal to the abnormal state was observed. It may be noted that the first readings were normal (table 1), for example a red cell count of 5.0 million, hemoglobin of 12 grams, hematocrit of 40 millimeters and a plasma specific gravity of 1.0287. In 5 hours, however, and after debridement, dressing, and tanning, the hematocrit, RBC, and hemoglobin were all notably elevated. This indicated dehydration from water loss; whereas the plasma specific gravity fell, thus showing plasma protein loss, without adequate replacement from the body protein stores. The patient was then given 600 cc. of plasma as indicated on chart 1. Initially plasma was not given, since there was no indication for it; i. e., no shock and no need for replacement. In 5 hours and for the next 30 hours, however, the patient passed through a critical phase which required careful observation and treatment.

Plasma was given in an attempt to keep the plasma specific gravity levels at or near the low base line of normal, namely 1.0255 as may be seen in chart 1. Likewise fluids by mouth and parenterally were given in order to bring the hematocrit, RBC, hemoglobin, back into the normal range and thus avoid severe and damaging dehydration; for dehydration, if severe and prolonged, can and will cause cell destruction. The remainder of the chart and figure illustrate that proper levels were reached and the patient survived without mishap the critical phase of the first 11 days. At only one point was the patient in shock, and that was 0830 on September 12. Here plasma administration promptly relieved the crisis. In spite of the continuously elevated WBC, there was no early elevation of temperature although later he became febrile, following which there was an onset of anemia. He then received blood transfusions and supportive therapy, and at present has almost completely recovered after a series of skin grafts.

Case 2.—This patient, a 42-year-old male, received deep third-degree burns on the face, head and neck, hands, forearms, and knees which, when added together, represented about 25 percent of the body area. High-combustible substances here also were responsible for the unusually hot flames.

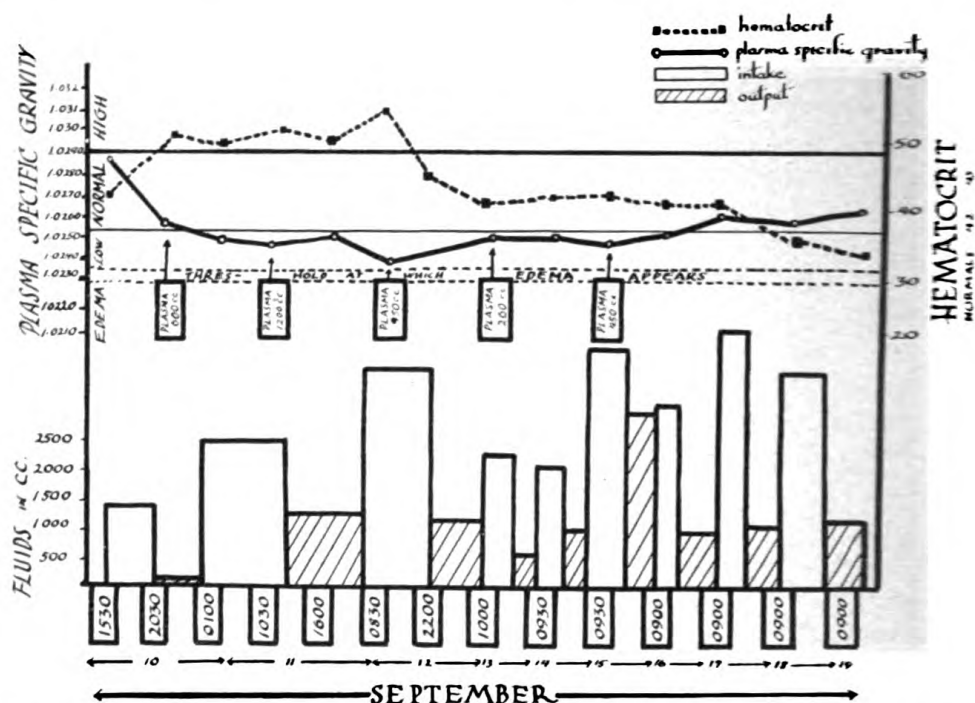


CHART 1.—Changes in the blood and plasma as affected by the indicated therapeutic measures in case 1.

This patient reached the hospital about 40 hours after the initial burns. Debridement was carried out at sea about 4 hours after the burns had been received, but only one unit of plasma was available for administration. This aided him to survive the initial shock state and reach a base. On admission his condition was critical and the first laboratory data were of unusual interest. The RBC was 9.0 million, the hemoglobin 21 grams, the hematocrit 62 millimeters, and the plasma specific gravity 1.0214 (corresponding to a total protein of 4.8 grams). Here, then, was severe dehydration along with a marked protein deficiency. This indicated that there had not been replacement of plasma protein from the body stores. This could be due to one or two factors, namely (1) depletion of the body stores and/or (2) inability of the body to release protein from these storage areas.

Table 4.—Laboratory data in case 2

Date	Time	RBC (mill.)	Hb. (gm.)	WBC	Plasma, specific gravity	Hematocrit	Blood	Plasma, cc.
Sept. 5.	1600	9.0	21.0	24,000	1.0214	61	-----	500
Do.	2000	6.39	16.5	14,000	1.0270	48	-----	-----
Sept. 6.	0045	6.9	17.8	14,800	1.0220	49	-----	500
Do.	1030	5.34	16.5	12,000	1.0226	-----	-----	500
Do.	1530	5.38	16.5	11,350	1.0260	40	-----	-----
Do.	2030	5.1	14.0	11,600	1.0252	38	-----	-----
Sept. 7.	0900	6.01	14.0	8,400	1.0254	39	-----	-----
Sept. 8.	0600	4.65	13.0	10,280	1.0248	36	-----	500
Sept. 9.	0900	4.82	13.5	9,750	1.0257	41	-----	-----
Sept. 10.	0900	5.33	13.0	12,500	1.0258	39	-----	-----
Sept. 11.	0900	4.33	-----	10,350	1.0255	39	-----	-----
Sept. 12.	0900	5.1	13.0	12,500	1.0288	39	-----	-----
Sept. 15.	0900	4.2	13.0	13,000	1.0260	39	-----	-----

Plasma was first given to this patient, for it is physiologically necessary that the plasma proteins be elevated before the circulatory system can retain an adequate amount of water and electrolytes. Five hours after this replacement it may be seen that two things had been accomplished, namely the plasma proteins were elevated temporarily to the normal range, and the hematocrit and RBC fell, indicating that dehydration was being overcome. It also may be noted that excessive amounts of water and other fluids by mouth were not necessary, and if given they might have tended further to dilute the total circulating protein which we were attempting to maintain. It is also evident in this case that plasma, oral and parenteral fluids, were administered according to specific needs. This

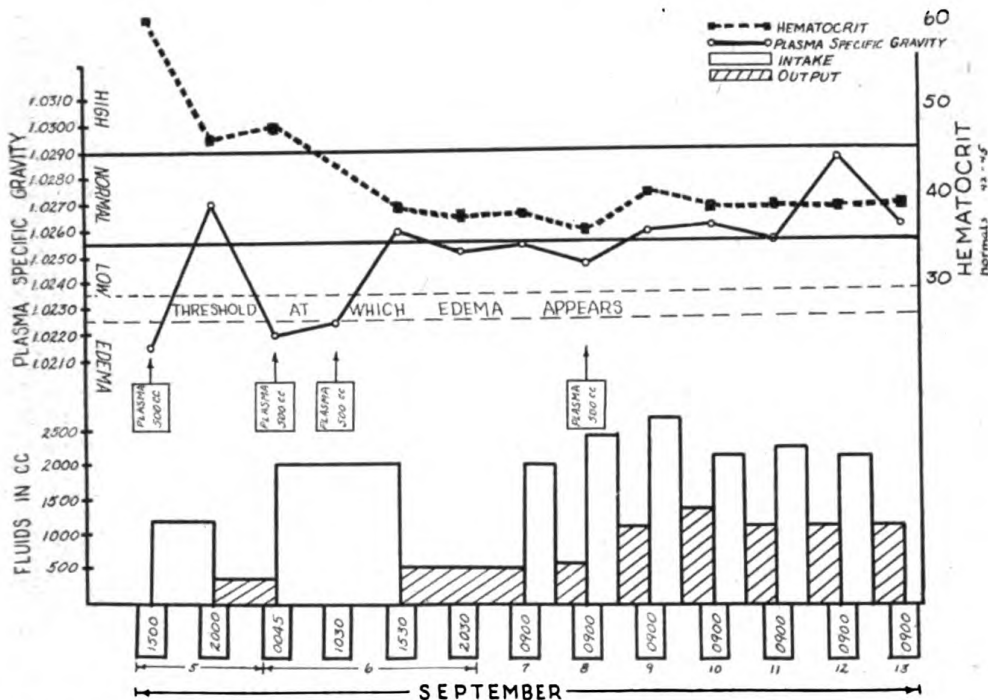


CHART 2.—Changes in the blood and plasma as affected by the indicated therapeutic measures in case 2.

patient's course represents a long and hard battle, but during the preliminary critical phase he never relapsed into a shock state. Considerable difficulty was encountered in skin reconstruction, but at present his prognosis is very favorable.

Case 3.—This patient, a 24-year old male, had a cholecystectomy performed. He had been suffering from gallbladder trouble for some time, and his condition immediately prior to operation was critical. About 12 hours after the operation the patient lapsed into a severe shock state. Initial readings revealed an RBC of 4.8 million, hemoglobin 14 grams, hematocrit of 31 millimeters, and a plasma specific gravity of 1.0336. This was very high, and although the blood counts alone appear fairly normal we knew from the plasma evaluation that severe dehydration was present. Here then it was evident that the interstitial reservoirs of the patient were depleted or low because of plasma concentration. Consequently, intravenous fluids were needed first to meet the oxygen demands of the tissues by reestablishing an adequate circulation. A progressive reduction of the hematocrit and cell counts indicated slow bleeding which was controlled by blood transfusions. The patient, once brought out of shock, showed clinical

TABLE 5.—Laboratory data in case 3

Date	Time	RBC (mill.)	Hb. (gm.)	WBC	Plasma, specific gravity	Hema- tocrit	Blood, cc.	Plasma, cc.
Sept. 24	2300	5.53	15.8	8,600				
Sept. 25	0900	4.8	14.0	16,350	1.0326	30		500
Sept. 25	1400	3.9	9.5	11,850	1.0290	26	1,000	500
Sept. 25	1900	3.5	9.5	11,000	1.0282	25		
Sept. 26	0900	3.05	9.3	11,000	1.0309	22		
Sept. 26	2000	4.4	9.5		1.0320	23	500	
Sept. 27	0900	3.43	9.5	9,500	1.0320	23		
Sept. 28	0900	3.45	10.5	6,900	1.0330	25		
Sept. 29	0900	3.94	10.8	5,980	1.0300	26		

improvement and he was allowed to remain moderately dry, as is revealed by the plasma specific gravity readings. This was done because any large increase in blood volume might have had a tendency to promote further hemorrhage.

THE USE OF PIPETTE PYCNOMETERS IN THE MEASUREMENT OF PLASMA SPECIFIC GRAVITY

The apparatus necessary consists of an accurate analytical balance, a special plasma pipette, and a thermometer. The method is simple and constitutes the weighing of the plasma filled pipette. As to the blood sample, either serum or plasma may be used for the weighing. Plasma, however, is more accurate since the fibrinogen is included.

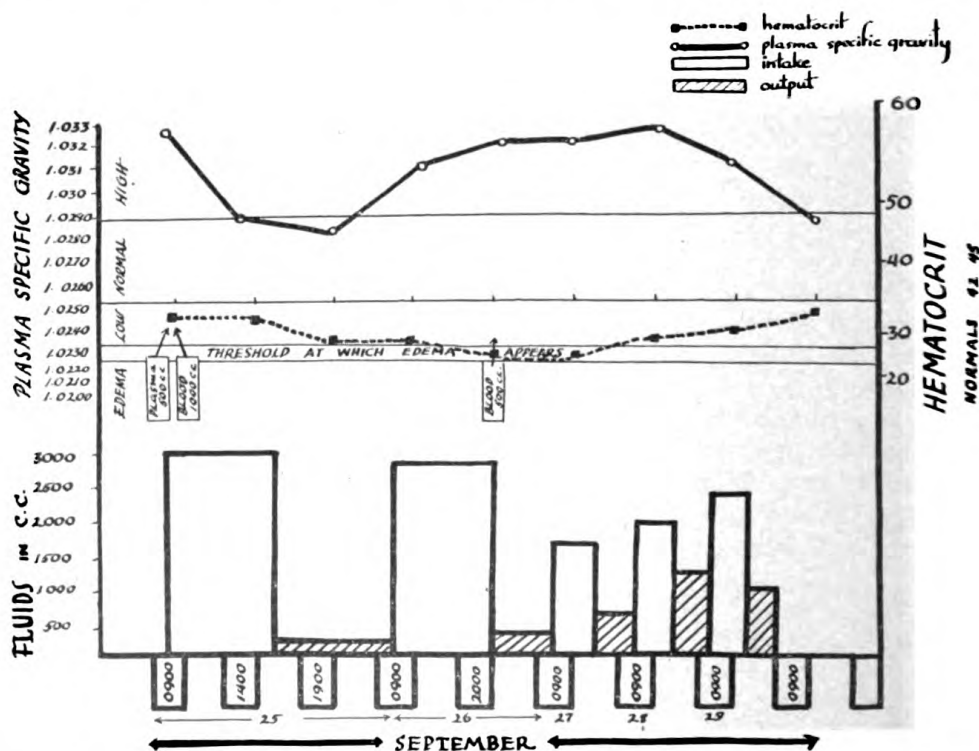


CHART 3.—Changes in the blood and plasma as affected by the indicated therapeutic measures in case 3.

The serum, however, weighs less, not only because of the lack of fibrinogen, but also because of the absence of any anticoagulant.

If oxalate is used, 5 cc. of blood is delivered to a bottle containing 4 mgm. of potassium oxalate and 6 mgm. of ammonium oxalate (10). This anticoagulant assures the stability of the red blood cell size by eliminating fluid interchange and hemolysis. The blood is then centrifuged at 2,200 r. p. m. for 3 to 4 minutes.

The pipettes which are used resemble those employed in counting blood cells. The 1-cc. size is most desirable. Their outlet is very small and the fluid once measured to the meniscus will remain there because the outlet becomes partly sealed by coagulation and the fluid column is likewise immobilized by capillary adhesive forces. Once the level has been reached the pipettes may be inverted, tilted, and left for a reasonably long period of time without changes in weight or meniscus, since errors due to evaporation and mechanical loss are eliminated. The plasma filled pipette is then weighed and recorded to the fourth place. The temperature of the plasma is taken while the filled pipette is being weighed. The pipettes are cleaned and dried by suction with water and acetone, but not ether.

TABLE 6.—*Table of various weight and volume changes of water at different temperatures encountered in the laboratory*

Tempera- ture (centi- grade)	Weight of 1 cc. of water	Volume of 1 cc. of water	Tempera- ture (Centi- grade)	Weight of 1 cc. of water	Volume of 1 cc. of water
15	0.9979	1.0021	23	0.9966	1.0034
16	.9978	.0022	24	.9964	.0036
17	.9977	.0023	25	.9961	.0039
18	.9975	.0025	26	.9959	.0041
19	.9973	.0027	27	.9956	.0044
20	.9972	.0028	28	.9954	.0046
21	.9970	.0030	29	.9951	.0049
22	.9968	.0032	30	.9948	.0052

Table from Landölt and Bornstein: TABELLEN.

All readings are expressed in terms of 20° C. The temperature correction factor is to be added for readings above 20° C. and subtracted for readings below 20° C.

The weight of the clean dry pipette is subtracted from that of the plasma-filled pipette, to give the weight of the plasma in the above formula. Since the volume is stationary, only the plasma specimen need be weighed, except for occasional restandardizations with distilled water to check any changes that might result from cleaning processes. This may be rarely necessary, for with careful routine cleaning there will be no change in weight. The capacity of the pipette may be calculated from the weight of distilled water as recorded in table 6. The temperature correction factor may be obtained from chart 4. This corrects to 20° C. in terms of which all values are expressed.

The total protein content of the plasma may be computed from the plasma specific gravity by the following formula (7) :

Total protein in grams per 100 cc. plasma equals $343 \times (\text{Plasma specific gravity} - 1.007)$.

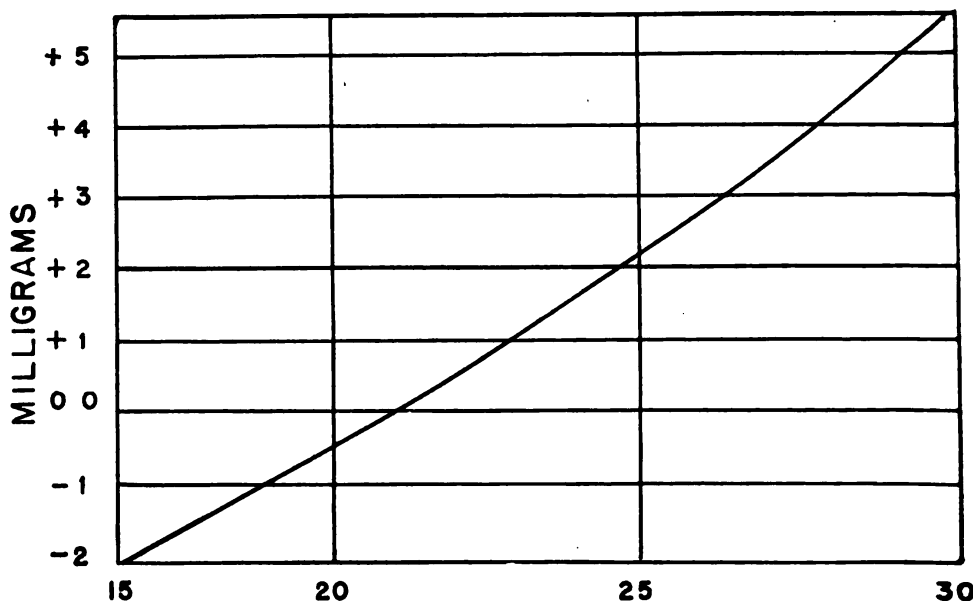


CHART 4.—Temperature correction factor (degrees centigrade) for the plasma specific gravity formula. (Moore and Van Slyke (7).)

Plasma Specific Gravity equals:

$$\frac{\text{Weight of plasma in pipette} \pm \left(\frac{\text{capacity of container in cc.}}{2} \times \text{temp. factor} \right)}{\text{Weight of distilled water in pipette at } 20^{\circ} \text{ C.}}$$

As compared with the falling drop method the following may be said: (1) The determinations may be done with greater accuracy since the errors that might occur in the timing of the drop and the control of standard solutions are eliminated; (2) the pycnometer method eliminates the use of nomograms (except for the temperature correction factor); (3) the pipettes are very economical as compared with the cost of the falling drop apparatus and its replacements. It may be said that one may place considerable confidence in the plasma specific gravity measurement as concerns therapy. As long as the readings are accurate, the fluid needs of the patient may be shown by actual measurement. Both the falling drop method and the pipette pycnometer thus may be used to obtain such valuable measurements.

SUMMARY

Formulas for shock therapy have been offered by various investigators. These are helpful, but repeated measurements of fluid balance are more exact.

Laboratory aids in the form of the red cell count, the hemoglobin determination, the white cell count, the hematocrit and plasma specific gravity measurements are discussed.

Illustrative cases are briefly presented which utilize these laboratory tests in guiding therapy.

A pipette pycnometer method for determining plasma specific gravity is described.

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THE LOAD OF THE HEART

Physiologically the work of the heart is normally determined by its load. The load can be defined in one or both of two terms: First, the resistance against which the heart works, which is the mean pressure in the aorta and pulmonary artery; second, the pressure head for filling, which is the mean pressure in the vena cava and right auricle on one side and in the left auricle and pulmonary veins on the other. In considering the physiologic pathology of the heart, it is just as important to know the load of the heart as it is to know its contractile power. As a matter of fact, it is clinically impossible to evaluate contractile power except in terms of load.—Meek, W. J.: Physiology of the heart and circulation. *Wisconsin M. J.* 42: 585-589, June 1943.

ALLERGIC REACTION TO DRIED HUMAN PLASMA¹

WILLIAM J. COLONNELL

Lieutenant Commander (MC) U. S. N. R.

There have appeared in the literature recently, scattered reports of reactions with pooled blood plasma; Polayes and Squillace (1), and more recently T. McKean Downs (2) reported reactions with dried human plasma. No satisfactory explanation has been promulgated. The possibility of and investigation into any allergic factor being present is not mentioned in the reports reviewed. From the description of the case reported by Downs, the reaction could be considered as of that nature.

Theoretically blood plasma transfusions when properly performed should produce no reactions except possibly allergic. These have been known to occur with whole blood transfusions; Vaughan and Pipes (3) and other investigators have reported infrequent occurrence of allergic reactions following transfusions of whole blood. It would therefore seem possible that human blood plasma could produce the same reaction.

The purpose of this report is to present a case of allergic reaction following blood plasma transfusion, and also to demonstrate the presence of an allergen in dried human plasma.

The patient investigated was a white male adult under hospital care for persistent intestinal bleeding. There was no family history of allergy and no history of allergy in the patient himself. He had been given several blood transfusions, whole blood, without any reaction. In November he was given a transfusion of whole blood from a type-A donor, with no reaction. One month later the same donor gave another whole blood transfusion followed by the development of a slight urticaria. A few minims of adrenalin cleared this condition quickly. Four weeks later the patient was given activated pooled blood plasma. When about 175 cc. had been given, the patient began to flush, his eyes became congested, with lacrimation. The plasma transfusion was immediately stopped and he was given 0.1 cc. of adrenalin 1:1000 intravenously. His eyes then started to swell and he developed marked and broadly diffused urticarial wheals. Periorbital and laryngeal edema set in. He was then given 0.5 cc. of adrenalin intramuscularly. Dysphagia, dyspnea, and dysphonia

¹ Received for publication March 11, 1943.

developed. The uvula and soft palate were so swollen that it was difficult for him to breathe. His chest at this time was full of musical râlés. He was given another dose of adrenalin intramuscularly and from then on his symptoms gradually receded. Four hours later he was fairly comfortable, and after 24 hours his symptoms had practically all disappeared. Because of his continued loss of blood it was subsequently necessary to give him several whole blood transfusions and he was also given several doses of human blood serum albumin. All were given without any reaction.

Intradermal skin tests upon the patient produced a 3-plus reaction with ragweed and 1-plus with the same activated plasma that was used in transfusion, diluted 1:10. Control was negative.

Tests upon the donor were carried out. Unfortunately he was detached from the hospital before a complete series of tests could be performed, but enough were done to be diagnostic. He presented a family history of hay fever on his mother's side. He stated that when he passed fields of weeds, he developed lacrimation, sneezing, and running nose. He came from Missouri. He had noticed frequent attacks of sneezing in the summer but did not consider himself a hay-fever victim. Intradermal tests produced 3-plus reaction with ragweed, 2-plus reaction with mixed grasses, and 3-plus reaction with the plasma 1:10. It was felt that this donor transferred antibodies to the patient. Numerous cases of passive transfer of antibodies have been reported. Ramirez (7) reported a case in 1919. Holder and Diefenback (8) in 1932 reported a case of urticaria when eating strawberries, following a transfusion from a donor who all his life had developed violent urticaria after eating strawberries.

Passive transfer tests were then carried out with the blood of this patient, the blood having been obtained prior to his subsequent transfusions. Three different nonallergic individuals were used. Tests included foods, pollens, inhalants, and the plasma used in the reaction. The results follow.

Subject C. J.:

3-plus reaction with 20 units ragweed on sensitized area. Negative on normal skin.

2-plus reaction with mixed grasses on sensitized area. Negative on normal skin.

2-plus reaction with 1:10 plasma on sensitized area. Negative on normal skin.

All other tests negative.

Subject F. R.:

3-plus reaction with 100 units ragweed on sensitized area. Negative on normal skin.

2-plus reaction with 1:10 plasma on sensitized area. 1 plus on normal skin.

All other tests negative.

Subject B. R.:

2-plus reaction with 10 units of ragweed on sensitized area. Negative on normal skin.

2-plus reaction with 1:10 plasma on sensitized area. 1 plus on normal skin.

All other tests negative.

This demonstrates the presence of ragweed antibodies in the blood of the patient. It also shows positive reactions on the sensitized areas with plasma of 1:10 dilution, demonstrating the presence of an allergen in the pooled plasma or antibodies to the plasma in the patient's blood. Lichtenstein (4) demonstrated that pooled dried serum after 7 months continued to give good passive transfer tests with pollens. The antibodies are not destroyed by drying and we know that allergens can be passively transferred by transfusion, as reported by several investigators. Duke and Stofer (5) reported a reaction in a woman sensitive to milk, she receiving a transfusion from a donor who had ingested a quantity of milk just prior to the transfusion. It should then follow that a certain allergen could be present in the pooled blood plasma and it react with antibodies in the blood of the patient. Ragweed was suspected, as the activity had not been entirely destroyed by the heat of drying in the preparation of the plasma. Arbesman and Eagle (6) showed that pollen extracts are thermolabile and lose 50 percent to 75 percent of their reagin-neutralizing activity within 15 minutes at 56° C.

The reactivated pooled blood plasma used in this case was then used for skin tests upon known ragweed-sensitive individuals, upon allergic individuals not sensitive to ragweed, and upon nonallergic persons, with the following results:

	Blood plasma 1-10	Control
8 known ragweed-sensitive.	6 gave 2-plus..... 1 gave 4-plus..... 1 gave 1-plus.....	Negative. Do. Do.
8 allergic but not to ragweed.	3 gave 1-plus..... 5 were negative.....	Do. Do.
10 nonallergic.....	2 gave 1-plus..... 8 were negative.....	Do. Do.

Lichtenstein (4) showed that after 6 months of aging, dried serum begins to cause an inflammatory reaction in normal skin. This reaction he feels is related to a so-called nonspecific tuberculin reaction. This might well explain the 1-plus reaction in some of the individuals tested. But a definitely greater reaction was produced in ragweed-sensitive patients which could be explained only by the presence of ragweed allergen in the plasma.

Allergic reactions result either from the introduction of an allergen contained in the blood of the donor into a recipient who has the cor-

responding antibody circulating in his blood, or from the passive introduction of an antibody into an individual who carries the antibody in his blood and develops a reaction when he comes in contact with the specific allergen. In the case reported the recipient received by transfusion the antibody and was subsequently given the allergen present in the pooled dried plasma, producing an allergic reaction. It must be borne in mind that this patient was given plasma because of hypoproteinemia and not because of secondary shock. Also the incidence of allergic reaction with plasma prerequisites so many factors that its occurrence should be rare and easily handled. Allergic manifestations of minor nature could and do occur, but due to the high dilution of any allergen present they are usually insignificant.

This case in itself demonstrates the remote possibility of reactions with pooled dried blood plasma. The fact that thousands of plasma transfusions have been given without reactions is probably due to the caution in collecting blood and dilution factor in pooling. The question of blood donors as to allergy; the taking of blood after a short fast; and the refusing of blood from individuals receiving any form of injection treatment is evidence of the safety of administration of plasma under proper supervision. The presentation of this article may throw some light on the few reactions which have occurred, and it should impress the necessity of having adrenalin handy in cases where blood plasma is to be used. It also demonstrates the presence of an allergen (ragweed) in pooled human plasma.

Note.—The plasma used came from a batch prepared in the Midwest in the month of August.

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A STERILIZATION PROCESS FOR POWDERED SULFONAMIDES^{1 2}

LESLIE A. McCLINTOCK
First Lieutenant (Sn.C.) A. U. S.
and

RAYMOND H. GOODALE
Commander (MC) U. S. N. R.

Since the advent of chemotherapy, it has become apparent that there exists a need for an efficient sterilization process for powdered sulfonamides. Since the war the vast increase in local sulfonamide therapy has brought the need for such a process to a place of great importance. Since the inception of this work, processes involving heat have been developed, but these have many limitations. The method to be described was designed to sterilize sulfanilamide-urea mixture or sulfanilamide alone in flexible insufflator tubes for use by service men in the field. Sulfanilamide-urea mixture melts at 131° C. with decomposition and cannot be thoroughly sterilized by heat. Because of the fact that sulfa drugs are more easily applied, and that they are better preserved from atmospheric changes in a plastic tube than in a paper envelope, this method would seem to have definite advantages over all other methods tried to date.

This method is based upon the use of two simple physical properties. The first is the insolubility, in the sterilizing agent, of the material to be sterilized. The second is the ability of the solvent or of the agent itself, to diffuse through an hermetically sealed cellulose acetate tube. In the former instance only a trace of the sterilizing agent is left on the surfaces of the sulfonamide crystals after diffusion of the solvent through the wall of the cellulose acetate tube. In the latter instance the sterilizing agent, mixed with the sulfonamide, is in itself volatile and capable of penetrating the insufflator tube walls.

Such treatment obviously kills only organisms on the surfaces of the crystals and in the interstices of the mass. It is not possible for this method to kill the organisms within the crystals. Our experiments have shown, however, that the possibility of viable intracrystalline bacteria or spores is very unlikely, since these substances (sulfonamides) are crystallized from solvents that kill the organisms. Although there are many eligible bactericides with the previously men-

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² From the Boston University School of Medicine, Boston, Mass., and the U. S. Naval Hospital, Chelsea, Mass.

tioned properties, few are useful for this type of sterilization. Formaldehyde and many other useful antiseptics of sufficient germicidal value to kill all organisms present will react with sulfanilamide. It is, therefore, absolutely necessary to use a substance which will neither dissolve nor react with the sulfanilamide or the cellulose acetate tube. It must also kill both spores and bacteria without producing any untoward effect upon a patient when the maximum amount of sulfanilamide is used. Some of the low molecular weight phenols were interesting in that they diffused out of the tubes after producing their desired effect. This diffusion, however, took place over a long period of time and for this reason these substances are not considered practical.

The phenols which produced the most desired effects were highly substituted and nonvolatile. The following phenols were tried irrespective of their possible toxic effects, merely to evaluate the scheme: Ortho-, meta- and para-cresol, thymol, chlorothymol, orthophenyl phenol, 2 chloro-4 phenyl phenol and tetrabromorthocresol. The best results were obtained with the last mentioned substance, which has a low toxicity and great bactericidal and fungicidal properties.

Since water could not be used, it was necessary to find a solvent which would not dissolve the tubes, plasticizer or sulfonamide, yet would dissolve the phenol. Benzene is not the ideal substance, although it possesses most of the desired qualities. It diffuses through the cellulose acetate membrane without seriously changing it. It readily dissolves the phenols and its solution with tetrabromorthocresol does not dissolve the sulfonamide or urea to any great extent. The one drawback is the fact that it allows hardly any of the tetrabromorthocresol to diffuse into the aqueous phase of the bacterial cytoplasm. Therefore, it is necessary to use much higher concentrations of the benzene solution to kill bacteria than would be called for with an aqueous solution. The addition of a small amount of alcohol, never exceeding 20 percent, partially overcomes this defect, perhaps through its changing the interfacial tension between the benzene and aqueous phases.

The sterilizing effect of tetrabromorthocresol was tested with the following organisms: Several strains of *Staphylococcus aureus*, a strain of *Eberthella typhi*, two strains of *Clostridium tetani* spores, *Aspergillus niger* and spores, a spore-bearing bacillus isolated from milk and a saprophytic bacillus. In another set of experiments a commercial preparation of sulfanilamide was tested as it was obtained. A variety of organisms was isolated from this product.

The sterilization of the sulfonamide was carried out as follows: 10 gm. of powdered sulfanilamide was placed in cellulose acetate tubes 12 by 1.5 cm. and having walls 0.5 mm. in thickness. The tubes were then inoculated with various bacteria as indicated in table 1. This powder was then impregnated with 3.5 cc. of solvent (benzene)

containing a total of 12 mg. of tetrabromorthocresol. From a practical viewpoint this amount was the minimal concentration of tetrabromorthocresol which would effectively kill all bacteria, and the volume of solution was the smallest amount which would completely wet the contents. The tubes were then hermetically sealed and allowed to stand at 30° C. for 48 hours. At the end of this time the solvent had evaporated through the walls of the tubes leaving the dry powder. After 48 hours the tubes were opened under aseptic conditions insured by thoroughly washing the surface with 10 percent phenol. An opening about 2 cm. in diameter was then fused out by means of a platinum loop. About 100 mg. of sulfanilamide was removed and inoculated into the following media: Beef heart infusion with 1 percent dextrose, thioglycollate and in special cases into Sabouraud's medium. To all of the culture media 5 mg. percent of para-amino-benzoic acid was added to inhibit the action of the sulfonamide. Except where a large inoculum of urea was added this was true. In this case the urea acted as an inhibitor of the p. a. p. a. action. Here it was necessary to centrifuge the inoculated tubes, pour off the supernatant and add fresh media under aseptic conditions.

In the case of our two strains of *Cl. tetani* neither sulfanilamide alone nor sulfonamide and urea would inhibit growth.

TABLE 1.—*Tests of sterilizing effect of tetrabromorthocresol*

Organism	Condition of inoc.	Amount added	Number tubes treated	Meat inf. original 72 hours	Meat inf. sub. cult.	Thioglyc. original 72 hrs.	Thioglyc. sub. cult.	Sabouraud's 72 hours
Staph. aureus.....	¹ C	Liquid.....	10	10+	10+	10+	10+	—
	T	do.....	20	20—	20—	20—	20—	—
Staph. aureus.....	C	do.....	4	4+	4+	—	—	—
	T	do.....	4	4—	4—	—	—	—
Staph. aureus.....	C	do.....	10	10+	10+	—	—	—
	T	do.....	10	10—	10—	—	—	—
Eberth. typhi.....	C	do.....	10	6+	6+	5+	5+	—
	T	do.....	10	10—	10—	10—	10—	—
Milk spore bearer.....	C	do.....	8	8+	8+	—	—	—
	T	do.....	8	4 4—	4 4—	—	—	—
Aspergillus niger.....	C	Dry spores.....	8	8+	8+	—	—	—
	T	do.....	8	8—	8—	—	—	—
Clostridium tetani.....	C	2 strains dry spores	15	10+	15+	15+	10+	—
	T	do.....	35	15—	35—	35—	15—	—
Mixture of saprophytic bacillus Staph. aureus	C	Liquid.....	10	10+	10+	10+	10+	10+
Asper. niger.....	T	do.....	—	10—	10—	10—	10—	10—
No organisms (sulfanilamide) ² added.	C	—	25	15+	18+	16+	18+	7+
	T	—	45	45—	45—	45—	45—	45—

¹ C Control tubes, no tetrabromorthocresol added. T Tubes treated with tetrabromorthocresol.

² Drug obtained from the manufacturer.

Following is a list of the sulfa drugs used in the experiment and the organisms used to infect each:

Sulfanilamide: Staphylococcus aureus
Milk spore bearer
Clostridium tetani
Aspergillus niger
Sulfanilamide-urea: Staph. aureus
Aspergillus niger
Clos. tetani
Eberth. typhi
Sulfathiazole: Staphylococcus aureus
Clostridium tetani

Preparations were tried in which the diameter of the powder particles ranged from 1 mm. to 0.17 mm. In no case did the size of the particle have any effect upon the sterilization process nor did the processing alter to any degree the properties of the powder.

Referring to table 1, two rather important points stand out. In all cases where vegetative organisms were used in liquid the process was entirely successful, but in some instances where a spore bearer was used in liquid suspension, the sterilization was unsuccessful. However, when dried powdered spore bearers were added, they were killed. It was later shown that shaking the plastic tubes for an hour in a Kahn shaking machine resulted in complete sterilization of the powder.

The second interesting point is the fact that *E. typhi* failed to grow in some instances in tubes inoculated from untreated tubes. This suggests that urea-sulfanilamide which was used in these tubes was concentrated sufficiently to kill *E. typhi*.

An experiment in which two combined strains of *Cl. tetani* spores were tested was run in another laboratory. Twenty tubes were inoculated with 400 mg. of sulfanilamide containing the tetanus spores from 0.4 cc. of a combined culture grown for 2 weeks in thioglycollate media. This inoculum was added to tubes containing 10 gm. of a 1:3 mixture of sulfanilamide and urea and these were sterilized in the manner described above. The tubes were opened after 48 hours and part of the contents added to thioglycollate medium for culturing. Two subcultures were made during the experiment, but in no case was there any growth. The tubes which were untreated, however, showed growth in all cases and in all subcultures. A similar experiment was run in which no infecting organism was added. These tubes showed effects similar to those obtained previously, namely, no growth after treatment.

Detailed experiments of tetrabromorthocresol to be reported later show that both in vitro and in vivo (wounds) this substance acts synergistically with sulfanilamide and sulfathiazole to produce a more marked effect.

Studies on local and systemic toxicity show that tetrabromorthocresol is absolutely nontoxic in oral doses of 100 mg. per kilogram when fed for as long as 20 days to rabbits. This amount is far more than any patient would ever receive. Ehrlich³ also found that this substance was nontoxic and a very active bactericide. As little as 0.3 mg. percent of tetrabromorthocresol in meat-infusion-dextrose broth killed 0.01 cc. of a 48-hour broth culture of *Staphylococcus aureus*.

³ Ehrlich, P., and Bechold, H.: *Ztschr. f. physiol. Chem.* 47: 173-199, 1906.

CONCLUSION

A method of sterilizing sulfonamides and sulfonamide mixtures at low melting point in plastic insufflator tubes by means of treatment with a chemical is presented. The sterilizing agent, tetrabromorthocresol, is dissolved in benzene and is added to the sulfonamide in the tube. After 48 hours the benzene has evaporated through the wall of the plastic tube leaving the sterile powder.



SUBCUTANEOUS ADMINISTRATION OF SULFONAMIDES

Occasions arise when the oral administration of the sulfonamides constitutes a serious practical difficulty in the clinical management of the patient, or becomes an actual impossibility. The usual procedure, when confronted with such a situation, is to administer the drug, in the form of its sodium salt, intravenously. A serious defect is associated with this approach, for under these circumstances a peak concentration is reached in the blood soon after administration is completed, which rapidly falls off as the drug is excreted.

The alkaline aqueous solutions of the sodium salts of drugs like sulfapyridine are extremely irritating and the subcutaneous administration of such solutions might cause severe local reactions or actual tissue destruction. This is true when concentrations of the order of 10 percent or higher are administered subcutaneously to experimental animals. Such experimental animals, however, tolerate the subcutaneous administration of 1 percent aqueous solutions of the anhydrous sodium salt of sulfathiazole without showing any sign of tissue reaction, and only a transient hyperemia results from the subcutaneous administration of a 5 percent solution.

On experimental animals sodium sulfadiazine appeared to be slightly more irritating than the sodium salt of sulfathiazole. However, the administration of equal quantities showed that the sulfadiazine salt gave rise to much higher blood concentrations than did the sulfathiazole salt, and traversed the cerebrospinal barrier more readily than does sulfathiazole. This suggested to try sodium sulfadiazine in the treatment of a number of cases of meningitis. No local reactions were observed.

More recently, the administration by hypodermoclysis of $\frac{1}{2}$ to 1 percent solution of sodium sulfadiazine to infants without resulting in a single local reaction is reported. Repeated subcutaneous injections of solutions up to 5 percent without any deleterious reactions have been used.

It is concluded that: (1) Higher blood levels are attained after the administration of sulfadiazine than result from the administration of comparable doses of sulfathiazole. (2) Cerebrospinal fluid concentrations of the drug are much greater after sulfadiazine than they are after sulfathiazole.—Lyons, J. J. A.; Climenko, D. R.; and Gorham, L. W.: The subcutaneous administration of sodium sulfathiazole in various clinical conditions. *Am. J. M. Sc.* 205: 703-708, May 1943.

THE TREATMENT OF CHRONIC GONORRHEA WITH COMBINED SULFATHIAZOLE AND INTRA- VENOUS TYPHOID VACCINE¹

EUGENE A. HAND
Lieutenant (MC) U. S. N. R.

There were 628 admissions for gonorrheal infection of the male urethra at this United States naval hospital from September 1 to December 1, 1942. There were 596 individual cases, the balance being readmissions after recurrence. This recurrence rate was 1 per 21.28 cases.

A urethral smear was taken in each case before medication was begun. Sulfathiazole was then given every 6 hours for 15 days. This was discontinued earlier if the symptoms stopped or if some sulfathiazole complication appeared on the clinical horizon. A few were given weak potassium permanganate irrigations in addition to this.

Of these 596 patients, 485 or 81.37 percent were cured without recurrence and sent back to duty on or before the fourteenth hospital day. These we consider to be sulfathiazole cures. The average hospital stay was 10 days. The 290 white patients averaged 10.85 days, while the 195 colored averaged 8.8 days. This compares favorably with other reported results.

If all gonorrhea were to respond like this, the disease would be of only minor importance to the Navy. Unfortunately, 111, or 18.63 percent failed to be cured by 1 course of sulfathiazole. Though some of these responded to a second course, and a few responded on substitution of another sulfonamide, as a rule "once a failure always a failure" was our experience.

When we consider that these 111 failures were hospitalized a total of almost as many days as all the 485 sulfathiazole cures, it is easy to see why chronic gonorrhea is so important to the Navy. If many of these failures had not had their hospital stay shortened by the method of treatment presented in this paper, this would have been even more striking.

These chronic gonorrheics, particularly in civilian life where they are so often treated as ambulatory patients, are the chief pool from which new infections arise. Any method that shortens this infectious period is of value in cutting down the spread of this disease.

Various methods to raise the internal body temperature, such as hot baths, hot-water bottles, various so-called fever boxes, intravenous

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typhoid, and other foreign proteins, and even malaria therapy, have been tried in chronic gonorrhea with fair success. These results though better than with sulfonamides alone, have certainly not been spectacular. Our results in a few cases treated with hot baths and intravenous typhoid vaccine substantiated this.

These methods combined with simultaneous sulfonamides have been tried with much better results.

The purpose of this paper is to present the results in 52 patients treated with simultaneous sulfathiazole and intravenous typhoid vaccine. This method was chosen chiefly because it entailed the use of no expensive, bulky, or difficult-to-obtain equipment. It could also be adapted to shipboard or camp hospital as well as civilian or base hospital.

TECHNIO

During the hyperpyrexia period and until cure or failure was apparent, 1 gm. of sulfathiazole was given every 6 hours. The first intravenous injection of killed typhoid bacilli was preferably given in the morning so that the fever bout would be finished by rest time at night. The initial dosage arrived at after many trials was one-half to three-quarters billion bacilli. A few moments after this intravenous injection a chill occurred, followed by a rapid rise in temperature.

If the temperature rose to 104° F. or higher, no further intravenous injection was given during that treatment. Some, especially on the second treatment given after a 2- to 4-day period, failed to have a high enough fever peak. Nelson's² stepladder method, used by him and others in treating malaria-resistant cerebrospinal syphilis, was then used. This consisted of a second or third intravenous typhoid vaccine given when the temperature was already elevated from the earlier injection. The temperature in almost every case was boosted in this way to the desired level. We often gave the second injection when the temperature reached 101° or 102° F., without waiting for a further rise.

TYPE OF PATIENTS TREATED

These 52 patients were taken at random from the group that failed to respond to previously tried forms of treatment. They were all robust males between 17 and 38 years of age. The great majority were in the age group between 17 and 23. All but two had infected prostates diagnosed by finding purulent prostatic fluid on massage. These two had chronic gonorrheal infection of Cowper's glands.

² Nelson, M. O.: Effective method of protein fever treatment in neurosyphilis. *South. M. J.* 26: 424-429, May 1933.

Two had subsiding epididymitis in addition to their prostatic infection.

IMMEDIATE RESULTS

These patients were hospitalized because of one or more of the following signs or symptoms: Purulent prostatic fluid, urinary changes, an inflamed meatus, or a urethral discharge.

Thirty-five or 67.3 percent of these 52 were free of symptoms and sent to duty within 6 days. Usually freedom from symptoms was apparent within 48 hours after the second treatment. Seventeen or 32.7 percent had persistent signs or symptoms for 25 or more days.

FINAL RESULTS FROM THIS METHOD OF TREATMENT

Two of those who were immediate cures returned to the hospital after 24 and 30 days respectively, with recurrence of their infection. These may have been reinfections, but statistically we consider them recurrences and therefore failures. This leaves 33 or 63.4 percent cured by this method. Over half of these have been traced. These have been followed for 30 to 90 days. Among those that could not be traced, we admit that there may have been a few other recurrences.

Of those who were not immediate cures, all but 6 finally became symptom free and returned to duty. This time interval was from 25 to 65 days. As most would have cleared in this time with or without this combined treatment, we consider all of these failures.

These 17, plus the 2 failures above, equal 19 or 36.6 percent failures with this treatment.

We are continuing this method of treatment. We intend to report our further results at a later date.

FACTORS AFFECTING THE FINAL AND IMMEDIATE RESULTS

The type and amount of previous treatment had little effect on the results. We did find that a few prostatic massages prior to the fever treatments favorably affected the course.

Previously cured gonorrhea apparently did not affect the results. Those who had a persistent infection off and on up to the time of this form of treatment were not benefited by this or any other form of treatment.

Though a few had high fever peaks and failed to respond, and conversely some responded excellently on a low fever, it can be said that the higher and longer the temperature was elevated the better the results.

Though a few had only one fever treatment and were cured, we learned early that two treatments was the optimum number. Those

that did not respond to two treatments were not cured by subsequent treatments. All those who had more than two treatments in this series were failures.

Though it is unwise to draw conclusions from only six colored patients, our results were certainly better in the white patients. Four of the six colored patients were immediate failures, and three of these still have symptoms or signs of their infection at this time.

The appearance of herpes was of no prognostic significance in this series, or any indication that unusually high therapeutic pyrexia had been achieved.

COMPLICATIONS FROM THE TREATMENT

As those who were previously sensitive to sulfathiazole had been weeded out during their earlier sulfathiazole course, we expected no complications from this drug. None were observed. All continued to tolerate sulfathiazole.

That this is a pleasant form of treatment we would be the first to dispute. Almost every patient, starting with the chill, complained of headache, backache, retching, and general distress, and these symptoms increased as the temperature rose. Water demand was common with the temperature rise. Once the temperature reached its peak and began to drop, the symptoms usually subsided. An occasional patient had no complaints except for being warm and thirsty.

Four had complications serious enough to prevent further use of this combined form of treatment. Though due to this discontinuance a fair trial was not given, they were included in this series. These four were failures. One had severe spasm of the kidney region, two had excruciatingly severe backache, and one had spasm of the stomach and bowel. These symptoms were all promptly relieved by small doses of morphine sulfate.

No deaths occurred in this series.

Fifty percent developed herpes simplex. This is higher than is seen in malaria therapy or typhoid vaccine treatment of cerebrospinal syphilis.

Though a few were incapacitated for several days, most were up and about in 24 hours after the fever reached normal.

SUMMARY AND CONCLUSIONS

1. 81.37 percent of 596 patients with gonorrheal infection of the male urethra were cured with 1 course of 1 gm. of sulfathiazole every 6 hours for 15 days. The average hospital stay was 10 days.

2. 18.63 percent of these 596 failed to respond to 1 course of treatment. Most of them remained refractory on subsequent trials.

3. Chronic gonorrhea is most often refractory or resistant to treatment with the sulfonamides.

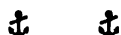
4. Fair results in chronic gonorrhea follow various fever therapy methods.

5. Much better results are obtained if simultaneous sulfonamides are given during the fever periods.

6. Of 52 chronic gonorrheics treated at a United States naval hospital with simultaneous sulfathiazole and intravenous typhoid-killed bacilli, 33 or 63.4 percent were cured in 6 days, and 19 or 36.6 percent were not cured.

7. The technic of this treatment is presented. It requires no bulky, expensive, or unusual equipment. It is adaptable to shipboard or camp-hospital conditions, as well as to civilian or base hospital practice.

8. The treatment is safe, though far from pleasant.



ENVIRONMENTAL TEMPERATURE AND MORTALITY IN BURNS

The common practice of covering the burned patient with a heated cradle may be definitely deleterious. Such a view has found expression during the past decade in several clinical reports on the treatment of burns. These studies suggest that even in temperate climates when the summer temperature rises to 100° F. or in tropical climates where this level may even be exceeded, air-conditioned rooms may well prove an important method of reducing the hazard of a fatal outcome due to severe burns. It also suggests that further investigations as to the influence of environmental temperature in other conditions will probably also reveal important influences from which therapeutic inferences may be drawn.—Editorial: Environmental temperature and mortality in burns. *J. A. M. A.* 121: 1353, Apr. 24, 1943.



THE CIRCULATION

The speed of blood flow in the arteries and veins, that is, the circulation time, has therefore been of great interest both to the physiologist and the clinician, and many ingenious methods have been used to determine it. If a solution of magnesium sulfate, calcium gluconate, and copper sulfate is injected into an arm vein, a hot flash is felt shortly afterwards in the tongue, perineum, hands and feet. Saccharin introduced in the same way gives a taste of sweetness. Cyanide will cause a sharp increase in respiration as it strikes the carotid sinus. Radioactive material may be injected and its arrival at a given place be determined by a Geiger counter. By these methods one may estimate the average speed of flow in the arteries and veins.—Meek, W. J.: *Physiology of the heart and circulation.* *Wisconsin M. J.* 42: 585-589, June 1943.

STUDIES IN MAINTENANCE OF INSTRUMENT STERILITY¹

S. ROBERT HOWELL
Lieutenant (DC) U. S. N.

The oral surgical instruments generally used during the day at the United States Naval Dental School are prepared as follows:

All instruments, gauze packs, towels, etc., are autoclaved at 240° F. 20-pounds pressure for 20 minutes as a routine daily procedure. The instruments are removed with sterile forceps and arranged in order on a sterile towel. They are then covered with a sterile towel. This is done every morning prior to the arrival of the first patient. When the instruments are needed they are removed with sterile forceps. During removal the sterile towel covering is lifted just long enough to seize and remove the instrument. These instruments that have been used are resterilized by boiling and returned to their original position on the instrument table under the same sterile towel.

In order to determine the efficacy of procedure for instrument sterility maintenance as practiced in the Oral Surgery Department of the United States Naval Dental School the following investigation was undertaken.

PART I

Twenty-four glass rods $\frac{5}{16}$ inch in diameter and 1 inch long were roughened with a circular stone driven by a motor. This was done to simulate, to some extent, the pits and serrations on instrument handles, etc. The rods were wrapped in cloth and autoclaved with other surgical instruments, packs, etc. Upon removal from the autoclave the instruments were placed on the table and the rods were divided into three groups of eight rods each and arranged diagonally across the instrument table on the sterile towel. One rod from each group was now placed in separate sterile test tubes each containing 2 cc. of sterile distilled water, and the contents of each poured into separate sterile Petri dishes. Ten cubic centimeters of sterile nutrient agar of the following composition:

Bacto—beef extract.....	5 gm.	} per 100 cc. of water
Bacto—peptone.....	5 gm.	
Bacto—agar	15 gm.	

were melted, cooled to 40° C. and poured into each of the Petri dishes. The Petri dishes were gently moved in a rotary manner in a hori-

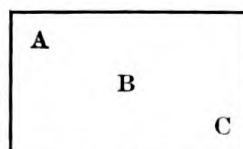
¹ Received for publication March 10, 1943.

zontal plane to mix the water and agar thoroughly. The contents were allowed to jell and were then incubated at 37° C. for 72 hours, after which colony counts were made. The first rod removed from each group immediately following the setup of the instrument table served as controls. Thereafter at hourly intervals one glass rod from each group (making 3 in all) was collected and treated as described above until the end of 7 hours, when all rods had been collected. A sterile technic in all procedures was observed throughout. The whole procedure as described was repeated 4 days in succession (table 1).

TABLE 1.—*Results of experiments in Part I*

Time of rod removal	Tuesday, Aug. 11			Wednesday, Aug. 12			Thursday, Aug. 13			Friday, Aug. 14		
	A	B	C	2A	2B	2C	3A	3B	3C	4A	4B	4C
1 { 0910....	0	0	1									
1 { 0910....				0	0	1						
1 { 0930....							1	0	0	0	0	0
1 { 0940....												
2 { 1010....	4	98	0							0	0	0
2 { 1011....				0	0	2						
2 { 1030....							0	64	0			
2 { 1035....										0	1	0
3 { 1112....	2	2	4									
3 { 1110....				0	1	0						
3 { 1129....							1	2	1	0	0	4
3 { 1135....												
4 { 1207....	334	0	1									
4 { 1209....				5	0	0						
4 { 1228....							0	0	0	0	2	0
4 { 1235....												
5 { 1258....	1	4	14									
5 { 1310....				1	0	2						
5 { 1331....							0	0	1			
5 { 1335....										0	1	0
6 { 1405....	1	1	173									
6 { 1410....				2	0	2						
6 { 1431....							0	1	0	1	0	0
6 { 1440....												
7 { 1505....	12	90	3									
7 { 1509....				1	0	1						
7 { 1532....							2	0	0	1	0	18
7 { 1540....												
8 { 1608....	0	3	4									
8 { 1608....				1	1	0						
8 { 1619....							2	0	2			
8 { 1630....										1	1	0

Discussion—Part I.—The three groups of eight rods each were laid diagonally across the table with group A being in the back left-hand corner as the operator faced the table, group B in the center and group C in the lower right-hand corner. The sterile towel was large



enough so that the instruments lay on one half while the other half acted as the cover with the folded edge at the back.

Series A, B, and C were performed on August 11; series 2A, 2B, and 2C on August 12; series 3A, 3B, and 3C on August 13; and series 4A, B, and 4C on August 14. In table 1 the vertical column on the left indicates the times at which the eight rods were removed from each of the three different groups on the table on each of the 4 days. The top horizontal column represents the four series performed on successive dates and the rod position on the instrument table. The numbers under each of these series represent the colony count in the agar plates, produced by culturing the water in which the glass rods were washed following their removal from the instrument table.

The first series performed on August 11 shows a relatively high colony count throughout in comparison to the succeeding days. This in part may be due to faulty technic since there is such multiplicity of steps involved and therefore opportunity for the introduction of errors. Exclusive of the first day the colony count is low. For the most part the count shows only a slight increase as the day progresses which would seem logical with repeated raising of the towel to remove instruments.

PART II

Nine sterile Petri dishes containing sterile nutrient agar were placed on a table in the same room as that where the previous experiment was conducted. One Petri dish with its 10 cc. of sterile agar was placed in the incubator to act as a control. The lid of the second Petri dish was removed for 10 seconds exposing the sterile nutrient

<i>Time</i>	<i>Colonies</i>
1. control	2
2. 10''	2
3. 20''	5
4. 30''	6
5. 40''	4
6. 50''	6
7. 60''	14
8. 70''	8
9. from 1630 to 0815	99 colonies and 12 fungi

agar to the air in the room. The lid was then replaced. One hour later the lids of Petri dishes No. 2 and No. 3 were removed and the agar exposed for 10 seconds and the lids replaced. An hour later the nutrient agar of Petri dishes Nos. 2, 3, and 4 was exposed to the air for 10 seconds and so on until the eighth Petri dish had been exposed to the air for 10 seconds. This meant that Petri dish No. 2 had been exposed 70 sec. in all during the experiment; No. 3, 60 seconds; No. 4, 50 seconds; No. 5, 40 seconds; No. 6, 30 seconds; No. 7, 20 seconds; and No. 8, 10 seconds. Petri dish No. 9 was exposed from 4 p. m. until 8:15 a. m. All dishes were incubated for 72 hours at

37° C. and colony counts made. This procedure was followed on the second day of the experiments of part I.

Discussion—Part II.—A general increase in colony count in proportion to the time exposed to the air is shown by the Chart 1 representing the results of Part II.

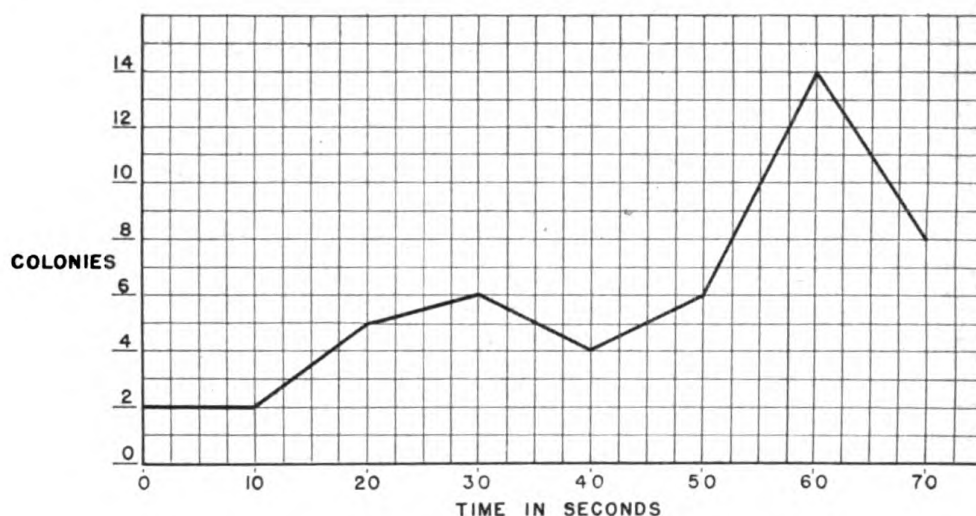


CHART 1.—Showing time-colony count relation in part II.

CONCLUSIONS

Exhaustive studies have been made on the bacterial content of air in operating rooms by Rice et al.,² in which he states that the importance of bacteria in the air has been overemphasized. He also concluded that the number of people and amount of activity in the room did not influence the bacterial count. Eliminating these and other variables from the simple experiments performed here at the United States Naval Dental School, we may conclude from our results that the methods of sterilization and maintenance of instrument sterility used here are efficacious within the limits of surgical asepsis.

² Rice, T. B.; Weed, L. A.; and Raidt, H.: Bacterial content of air in operating rooms. *Surg., Gynec. & Obst.* 73:181-192, August 1941.



LOCAL VERSUS SYSTEMATIC TREATMENT OF BURNS

It is wise counsel to advise the immediate general treatment of the patient rather than the burned area. It is pennywise and pound-foolish to consume invaluable time in applying perfect local dressings, while the patient is sinking into irrecoverable shock. * * * In severe burns, the systemic treatment often requires more skill and thoughtful attention than the local wound.—Pack, G. T., and Davis, A. H.: *Burns*. Lippincott, 1930.

SODIUM PENTOTHAL ANESTHESIA IN INTRA-ORAL SURGERY AT SEA ¹

CHALMERS R. CARR

Lieutenant Commander (MC) U. S. N.

and

DANIEL E. LAMOTHE

Lieutenant Commander (DC) U. S. N.

Pentothal sodium has become generally accepted as a safe and eminently satisfactory anesthetic for operations of short or medium duration. Although its popularity was growing rapidly in the period 1935 to 1941, satisfactory adaptation to war surgery has given it new impetus. We now find uses for it in procedures of ever-increasing length.

The dentist on shipboard has often found himself having to compromise with methods of choice because of the lack of suitable general anesthetic. Ships at present are not equipped with gas anesthesia apparatus. Ethyl chloride has a limited place, but is generally unfavorable for any except the very shortest procedures. Ether anesthesia requires prolonged induction and is associated with uncomfortable after-effects. Except when given transnasally by endotracheal tube it is generally unsatisfactory for intra-oral work.

There frequently arise oral conditions which require a general anesthetic. This day of long periods of absence, and great distances from completely equipped shore facilities, places the problem before each ship's medical organization. For these cases arising in ordinary dental and surgical practice and for wounds of the face and jaws we believe that intravenous anesthesia offers an answer to proper management.

The main safeguards necessary in intravenous anesthesia are hyperoxygenation of the patient and the maintenance of an adequate airway. Green (1) finds no deleterious effects from respiratory depression in intravenous sodium pentothal anesthesia, if the patient is given adequate amounts of oxygen during the anesthetic period. His observations are well considered and the simultaneous administration of oxygen is becoming more and more the general rule. The use of oxygen through nasal catheter overcomes the main objection to this agent for intra-oral surgery.

¹ Received for publication February 23, 1943.

We have been using a technic which requires only the apparatus available on any ship large enough to carry a dental officer. In reviewing the literature at hand, we find that Hubbell (2) described a similar technic for office practice. Jones (3), Bullard (4), and doubtless others have advocated the use of this agent in purely dental work. For those who may wish to pursue the study further Fischer (5) gives an excellent discussion of general anesthesia in maxillofacial surgery. No study of intravenous anesthesia is complete without reviewing the works of Lundy and his co-workers (6).

In this type of surgery, all cases, save the purely dental ones, should be a matter of close cooperation between the medical and dental officers. For example, injuries involving soft tissues and bones of the jaws certainly deserve the efforts of both, since a maxillofacial specialist is seldom available. The use of this technic, each administering the anesthetic for the other, will greatly foster this cooperation. In battle work the well-prepared dental officer may find a great field of usefulness, aside from the dental and oral cases, in supervising and administering all anesthetics.

TECHNIC

We have found preliminary medication of little importance; however, we usually give $\frac{1}{100}$ gr. of atropine subcutaneously. If the operation is one of election and is likely to be of some length, morphine sulfate is given. If the surgery follows trauma, this will very likely have already been administered.

With the patient in the recumbent position and the shoulders slightly raised on the operating table, induction is begun by venipuncture and injection of the solution. We have used 2½ and 5 percent solutions of sodium pentothal with no noticeable differences, except that the rate of injection must be adjusted to compensate for the strength of the solution. The total amount depends on the procedure and the patient, but can be learned only by experience. We have not exceeded 1.5 gm. in any case and most have taken slightly under 0.5 gm. For this reason it is our custom to prepare 1.0 gm. in a 20-cc. syringe and have another 0.5 gm. ready for instant preparation, if it seems that it will be needed.

A holding clamp for the syringe and a rubber connecting tube from the syringe to the needle is a convenience, but not a necessity. Other apparatus are in use, but we have found the simple method quite satisfactory.

As soon as induction has progressed to the point of relaxation a size 12 or 14 catheter is passed through each naris into the hypopharynx. Oily lubricants are avoided because of the danger of aspiration. Lubrication with normal saline solution containing 1

percent ephedrine sulfate is just as satisfactory. We prefer the two catheters to one since the likelihood of blockage is reduced by half.

The catheters are connected by a Y-tube with the flowmeter on the oxygen tank. For this purpose we use the flowmeter obtained from the supply depot, with the inhaler mask. We regulate the flow of oxygen to about 3 to 4 liters per minute, depending on the degree of cyanosis present. By slight adjustment it is simple to maintain a good color, a satisfactory clinical guide for safety. With the flow at this rate there is rarely any marked change in respiratory or heart rate. The use of the anesthetic presupposes an adequate knowledge of the signs and levels of anesthesia.

The desired depth of anesthesia is reached and maintained by the intermittent injection of the solution as required. When the jaw is relaxed and the anesthesia is at the proper level, a Denhardt mouth gag is placed on the unaffected side. The tongue is transfixed near the tip, lateral to the midline, with a cotton or silk suture, the ends of which are left long and clamped. We have found that this traction suture gives excellent control of the tongue, and prevents it from dropping back or obstructing the field. Less trauma is produced than with either a towel or tongue clamp, and after removal the patient is rarely aware of any tongue injury.

An aspirator is essential to remove all accumulated fluids. The assistant, usually the corpsman, is trained to use it constantly during the operation.

A layered gauze 4 by 4 inches square is folded and placed over the base of the tongue, care being taken not to occlude the pharynx by pressure on the soft palate. The pack protects this area and prevents the aspiration of foreign particles.

At completion of the surgery, the patient is turned on his side, mouth down and head held straight. As soon as the gag reflex begins to return the oxygen tubes are removed. If additional oxygen is needed it is given by the substitution of the mask for the tubes. The tongue suture is removed when the patient is nearly conscious and the danger of secondary asphyxia is past.

We do not leave our patients, or return them to bed until consciousness is complete. We believe that the aspiration of foreign material is less likely with this method than with ether anesthesia, with its prolonged recovery period and concomitant salivation and emesis.

We have used this technic for single and bilateral removal of tissue and bony impacted third molars, incision and drainage of abscesses, including one deep submental abscess with marked cellulitis (Ludwig's), removal of teeth with pericoronal infections, and curettement of bone. It has been repeatedly satisfactory for these procedures and we consider that it has great value in maxillofacial work.

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TREATMENT OF BURNS

As early as 1881, Tappeiner wrote: "The concentration of blood in burns occurs not through simple water loss but by loss of a fluid whose composition as to solids is close to that of blood plasma. * * * I consider as the cause of death in severe burns the concentration of the blood produced by transudation of plasma-rich fluid in the burned skin and recommend therapeutic transfusion of serous fluid."—Nash, C. C.: *Surgical Physiology.* Charles C. Thomas 1942. P. 61.



DECOMPRESSION FOR SMALL OR MODERATE INTRASPINAL PROTRUSIONS OF INTERVERTEBRAL DISCS

When is a disc protruded? There is no question about massive protrusions of intervertebral discs which represent an intraspinal mass a centimeter or more in diameter. But these large tumors which are so gratifying to excise represent the minority of lesions disclosed at operation. Ordinarily the surgeon finds a disc which bulges more or less. Love judges whether the disc is protruded or not by its resilience or consistency as well as by the associated changes in the nerve root—edema, inflammation, and possible adhesions. Since the intervertebral disc normally has a certain amount of intraspinal bulge, I consider a disc protruded only if it bulges more when the lumbar spine is extended as a result of the anesthetist's lifting the shoulders of the patient. This increase of protrusion on extension of the lumbar spine may seem paradoxical when compared with the fact that most protrusions begin when the lumbar spine is in flexion. However, the original protrusion is caused by a tear in the annulus fibrosus. The additional protrusion, when the lumbar spine is extended, is caused by a tendency of the posterior portions of the bodies of the vertebrae to act as pincers.—Ecker, Arthur: Decompression of protruded intervertebral discs. *J. A. M. A.* 121: 401-403, Feb. 6, 1943.

NASAL AND PHARYNGEAL IRRITATION FROM CONTACT WITH SUCROSE OCTA ACETATE AMONG OPERATORS OF COMPRESSED- AIR HAMMERS¹

FREDERICK J. VILES

Lieutenant, junior grade H-V(S) U. S. N. R.

During the first cold spells of this past winter, complaints were received from air-hammer operators concerning the use of alcohol in compressed-air lines. It was claimed that whenever alcohol was used to blow out the water and ice in the compressed-air lines, they experienced a very marked irritation in their noses and throats. This irritation lasted 3 to 4 hours and resulted in coughing and soreness of the throat.

An investigation revealed the following information:

1. This alcohol, which was used to prevent the water in compressed-air lines from freezing, was grade C United States Navy Specifications. It consists of 0.3 percent sucrose octa acetate (an alcohol soluble powder), 1 part red fuchsin in 500,000 parts, and grade A alcohol (undenatured).

2. Tests for alcohol vapor in air while one line was being blown out revealed concentrations around 2,500 parts of alcohol vapor per million parts of air. These concentrations lasted 2 to 3 minutes and are well below established safe maximum concentrations for such short exposures. During these tests everybody present experienced marked throat irritation which lasted 3 or 4 hours.

3. The only complaints received were from one location on the water front where the arrangement for adding this alcohol to the compressed air lines is different from that of the rest of the water front. In the latter case standpipes are used to add alcohol to the main compressed-air pipes at the beginning of each pier. In this way all lines from the main pipe are supplied with alcohol vapor and practically no liquid alcohol. Since no standpipes are accessible at the location from which the complaints were received, the alcohol is added to the hammer hoses at the manifolds. Using this technique the liquid alcohol is pushed through the hose and out through the hammer as a spray.

Except for varying concentrations of alcohol in air, the only difference resulting from the use of either one of the mentioned techniques

¹ Received for publication February 23, 1943.

for adding the alcohol is that one produced alcohol vapor or pure alcohol and water spray (standpipe arrangement), and the other an alcohol mist or spray of the original alcohol used (addition at manifold). The latter spray would contain all the original ingredients of the alcohol, namely, sucrose octa acetate and red fuchsin.

It was suspected that the sucrose octa acetate was responsible for the complaints of irritation. To verify this, concentrations of pure alcohol vapor ranging from 2,500 to 6,500 parts per million parts of air were set up and inhaled for 5 minutes. Slight irritation was experienced during exposure, no irritation after exposure. A fine spray of grade C denatured alcohol was set up and inhaled for a period of 5 minutes. This spray naturally contained sucrose octa acetate in the droplets of alcohol or as droplet nuclei resulting from the evaporation of alcohol droplets. Concentrations of alcohol ranged from 3,000 to 4,200 parts per million. Very marked irritation was experienced during exposure and lasted 4 hours after exposure. This irritation was exactly the same as that encountered when the air line was blown out.

Since abnormally high alcohol concentrations did not cause irritation, it can be concluded that the primary cause of irritation was the solid material used to denature the alcohol. The amounts of red fuchsin present are insignificant when compared with that of the sucrose octa acetate. Therefore the sole responsibility for the irritation encountered rests with the sucrose octa acetate. This conclusion is supported by Merck's Index (1940) which states that sucrose octa acetate is an intensely bitter powder.

To eliminate this exposure to sucrose octa acetate it has been recommended that accessible standpipes be installed which in turn would alleviate the possibility of forming alcohol mist or droplet nuclei of sucrose octa acetate in the air.



FUEL REQUIREMENT

The number of calories any one person requires for 24 hours for various activities can be determined with great precision. For general purposes this is not necessary; it is enough to state that for a moderately active person, 3,000 calories are adequate; for a very active worker, 4,500 calories; and for a sedentary worker, 2,500 calories. Soldiers require from 4,000 to 4,500 calories. The total metabolism of a boy from 12 to 14 years often exceeds that of his father.—Wohl, M. G.: A Guide to Practical Nutrition. Incidence of deficiency diseases protein requirements. Reprinted from Philadelphia Medicine, 1-4, 1941-42.

SULFATHIAZOLE NASAL JELLY FOR COLDS

Sulfathiazole nasal jelly was devised because of the reports as to the bacteriostatic action of the drug on streptococcic and staphylococcic infections of the nasal mucosa. The jelly was placed in sealed collapsible tubes because fresh solutions deteriorate within 1 week, even when kept in dark colored bottles.

No deterioration was observed in any of the tubes of jelly after a period of 8 months had elapsed.

About 30 physicians who used the method have reported marked clinical improvement.

Over 2,000 patients with colds have been treated with this jelly. Relief was reported in every instance except one, the patient in this instance using an oily spray (which destroys nasal ciliary activity) at the same time as the jelly.

If the whole tube's contents of 4 drams were taken either by nasal instillation or by swallowing, the patient would receive only the equivalent of a single dose or $7\frac{1}{2}$ grains of sodium sulfathiazole.—MacArthur, R. S.: Sulfathiazole nasal jelly for colds. *Clin. Med.* 50: 132, May 1943.



LAND-FILL DISPOSAL METHOD

The technic for the application of the land-fill procedure is fairly simple. It involves excavation of a shallow trench to secure a supply of earth cover material, deposition of refuse in this trench to a piled height of about 6 feet, compaction of the deposited material with a tractor and prompt covering of the refuse with at least 18 inches of earth.

The sanitary fill operation should not be confused with ordinary dumping of waste material which is exposed to the elements and an invitation to rodents and flies. If there are any rats or objectionable odors noticeable at a point further than 100 feet from the point of operation, a proper job is not performed.

In starting a fill a trench must be dug from 30 to 70 inches in depth, the earth from which is used to build a ramp from which the collection trucks will discharge their loads. This trench is dug for a length anticipated to provide space for about 2 months' disposal of refuse. After the initial fill has been completed the depth of succeeding trenches need be sufficient only to supply cover material for both the top or surface and the side slopes. Top cover material is never to be less than 18 inches of compacted earth and preferably should be 24 to 30 inches in thickness; thickness of the earth on the outside slopes is not to be less than 12 inches. Top and side cover of earth must be placed within 24 hours after refuse has been deposited.—Biaggi, N.: Land-fill disposal method. *Puerto Rico Health Bull.* 7: 85-88, June 15, 1943.

CLINICAL NOTES

TRAUMATIC ULNAR NERVE PALSY¹

NEUROLYSIS AND TRANSPOSITION OF NERVE THE OPERATION OF CHOICE

SAMUEL J. STABINS

Lieutenant Commander (MC) U. S. N. R.

and

WILLIAM H. MATHEWS

Lieutenant (MC) U. S. N. R.

The last war was responsible for much of the advancement of knowledge in the handling of peripheral nerve injuries. It is safe to assume that the incidence of this type of injury in the present war will at least be as great, if not greater. The following case is reported to stress the importance of early operation once the diagnosis has been established.

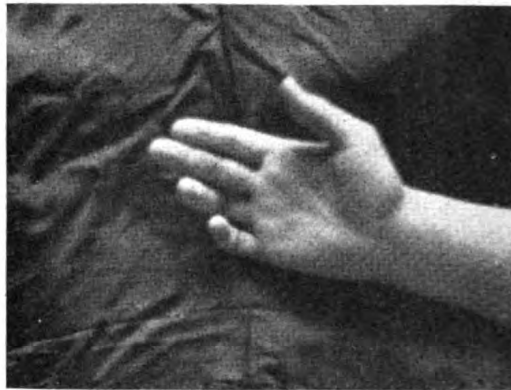
CASE REPORT

History.—On July 6, 1942, a 29-year-old physical instructor presented himself at this hospital, complaining of "wasting of his right hand". This condition had been brought to his attention 1 month previously, when he forcibly extended his arm while boxing. At that time he noticed swelling and local pain at the elbow joint. Within a few days numbness and tingling appeared on the inner side of the wrist and in the little and ring fingers of the right hand. Whirlpool baths to the elbow sufficed to reduce the swelling somewhat and to remove the local soreness. However, the numbness and tingling remained, and about 10 days later he noticed wasting of the muscles about the thumb and forepart of the hand. He also noticed that there was weakness in bending the wrist, the ring and little fingers. It is noteworthy in going over his past history that he had been engaged in athletics throughout his high school and college career. He does not remember any disabling injury to the elbow but does recall having frequently traumatized his elbow while playing football. He describes this trauma in the following manner: He played on the line and blocked his opponent with his elbow in a flexed position. Since he has been in the Navy he has been boxing and states that he uses his right elbow in a flexed position to ward off punches.

Examination.—Physical examination revealed an unusually well developed and muscular young man, 29 years of age, without any abnormalities except for the local condition. The right elbow was slightly swollen on its inner aspect, and just above the groove through which the ulnar nerve courses there was palpated a small, circumscribed, nontender nodule. Motions of the elbow

¹ Received for publication February 23, 1943.

joint were normal except for 10° of limitation in full extension. The muscular body of both forearms was identical except for a slight decrease of the flexor carpi ulnaris on the involved side. There was obvious atrophy of the hypothenar eminence as well as the palmar and dorsal interossei. This was especially marked over the dorsal interosseus muscle between the thumb and index finger. The phalanges of the ring and little fingers were hyperextended at the metacarpophalangeal joints and flexed at their middle and distal joints (figs. 1 and 2). There was inability to abduct and adduct the ring and little finger. The



1. PHOTOGRAPH ON ADMISSION. VOLAR ASPECT SHOWING FLEXION OF MIDDLE AND DISTAL PHALANGES OF RING AND LITTLE FINGERS, AS WELL AS ATROPHY OF THE PALMAR INTEROSSEI.



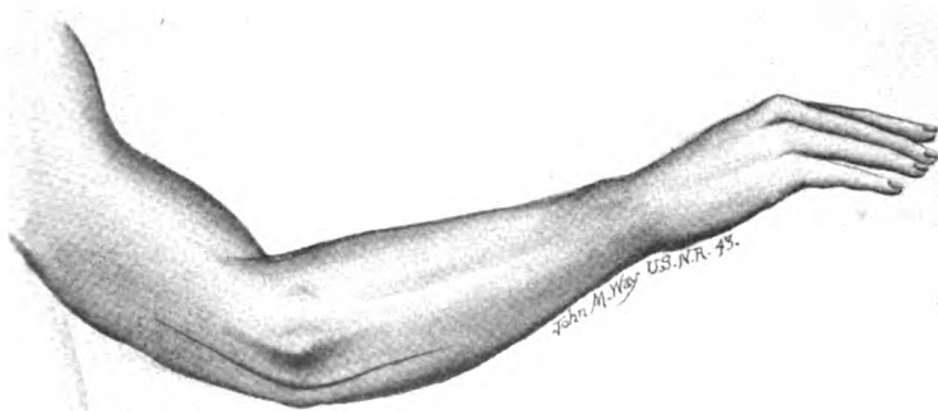
2. DORSAL ASPECT SHOWING MARKED ATROPHY OF THE DORSAL INTEROSSEUS BETWEEN THE THUMB AND INDEX FINGER. THE HYPEREXTENSION OF THE PHALANGES OF THE RING AND LITTLE FINGERS AT THE METACARPOPHALANGEAL JOINTS WITH FLEXION OF THE OTHER PHALANGES IS QUITE EVIDENT.

extended thumb could not be adducted. There was inability to flex the ring and little fingers at the metacarpophalangeal joints as well as inability to extend the middle and distal phalanges. There was hypo-esthesia along the ulnar side of the wrist on both volar and dorsal aspects which extended to the little finger and the ulnar side of the ring finger. X-rays of the right elbow revealed changes consistent with a post-traumatic degenerative arthritis. There was no actual evidence of fracture of the ulna (fig. 3). It was the opinion of the writers that although the present condition was noticed only 4 weeks ago, the injuries sustained over a period of years were responsible in no small way for his present disability.

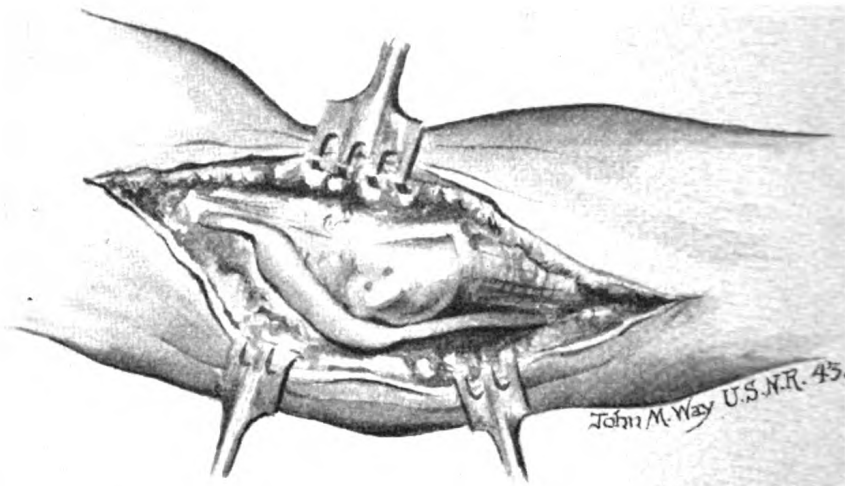


3. X-RAY OF RIGHT ELBOW. NO EVIDENCE OF FRACTURE MADE OUT BUT DEFINITE CHANGES CONSISTENT WITH A TRAUMATIC DEGENERATIVE ARTHRITIS ARE APPARENT.

Clinical Course.—Because of the swelling over the inner aspect of the elbow, a short course of whirlpool therapy was given over this area. This resulted in an increase in the paresthesia over the area complained of upon admission. Operation was performed on July 16, 1942, 10 days after admission. The procedure was done under local anesthesia. The operation consisted of a neurolysis and transposition of the ulnar nerve to the flexor side of the elbow (fig. 4). The ulnar nerve was identified in the groove in the back of the medial condyle.

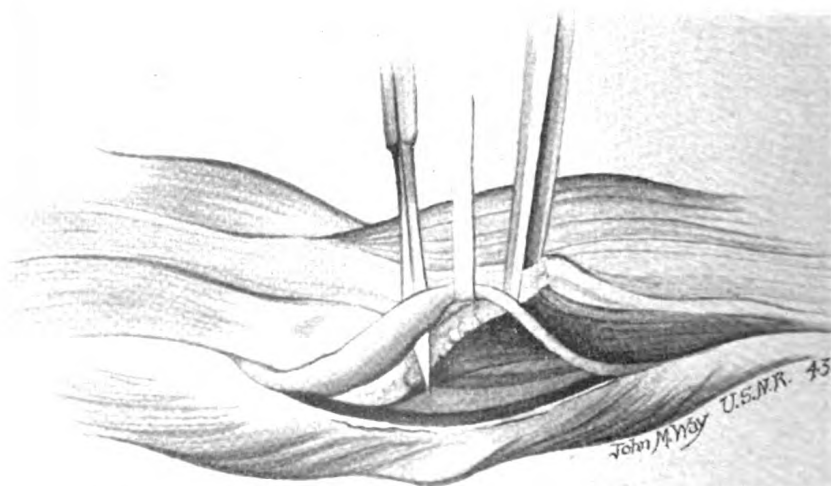


4. LINE OF INCISION ON THE INNER ASPECT OF THE ELBOW. EXPOSURE OF THE NERVE IS BEST OBTAINED BY HAVING THE FOREARM IN THE PRONE POSITION ACROSS THE PATIENT'S UPPER ABDOMEN.



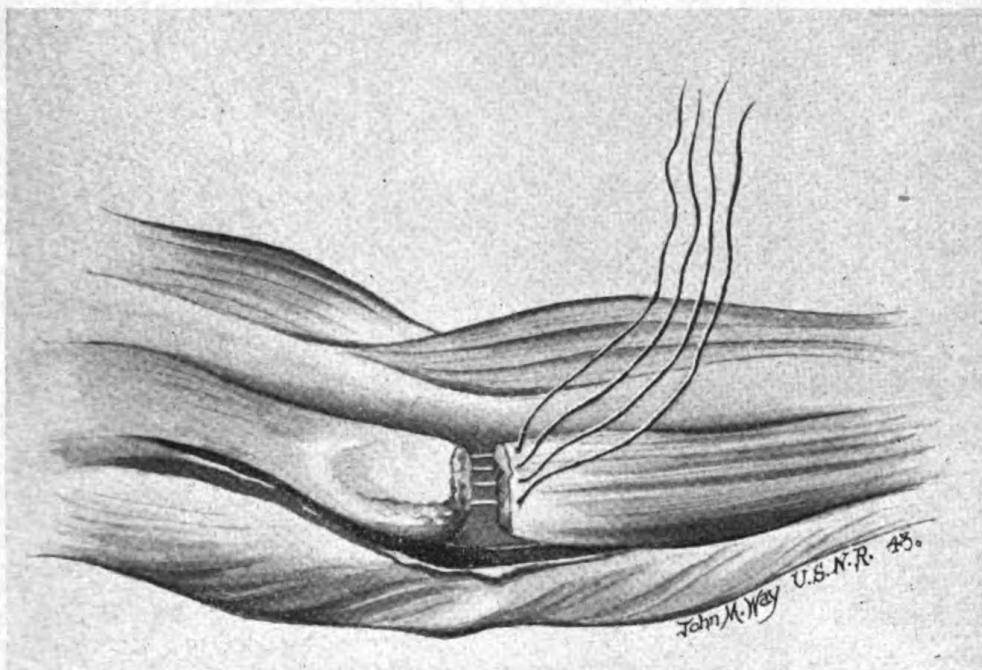
5. ULNAR NERVE BOUND DOWN TO THE SURROUNDING STRUCTURES. THE NERVE IS DISTORTED AS IT COURSES THROUGH THE GROOVE.

It was found to be bound down in dense scar tissue. The nerve entering the groove was bulbous and adherent. As it emerged from the groove, it became contracted, nonmobile, and nonadherent (fig. 5). It was freed until it disappeared between the two heads of the flexor carpi ulnaris. The nerve was then transposed to the flexor surface of the elbow (fig. 6). The pronator teres muscle was cut across and the nerve placed beneath the muscle belly. The muscle



6. THE ULNAR NERVE HAS BEEN BROUGHT ANTERIORLY. THE PRONATOR TERES MUSCLE IS BEING SEVERED TO RECEIVE THE TRANSPOSED NERVE.

was then resutured (fig. 7). This procedure prevented the nerve from slipping back to its old bed. No corrective operation was attempted on the elbow. Silk was used throughout. The field was relatively dry. All bleeding points were ligated with fine silk. The elbow was placed in partial flexion. It was the feeling of the writers that the preservation and transposition of the nerve was of primary importance and that no attempt should be made to correct the slight bony deformity that existed. It was felt that the disability of function of the elbow joint was not of sufficient severity to warrant any corrective attempts at this time.



7. THE NERVE HAS BEEN PLACED IN ITS NEW BED. THE PRONATOR TERES MUSCLE IS APPROXIMATED WITH INTERRUPTED MATTRESS SUTURES OF SILK.

Postoperative course.—Within 48 hours the hypoesthesia had diminished markedly and within 10 days had disappeared entirely. After the fourteenth day the elbow was gradually brought out of its flexed position. By this time the deformity of the ring and little finger had disappeared and there was a relatively normal relationship of the metacarpophalangeal and interphalangeal joints (figs. 8 and 9). There was not, however, any appreciable restoration of the atrophied muscles. There was marked improvement of abduction and adduction of the ring and little finger and adduction of the extended thumb. He was discharged from the hospital August 10, on his twenty-fifth postoperative day. The immediate recovery was striking, and when he was seen again in November, 3 months later, the improvement had been sustained. It is noteworthy, however, that despite this remarkable improvement in function the atrophy of the hypothenar region persisted.

DISCUSSION

The most common site for injury to the ulnar nerve is at that point where the nerve becomes most superficial, namely in the ulnar groove

at the elbow region. It has been estimated that about 90 percent of traumatic ulnar nerve lesions occur in this vicinity.

Flaccid paralysis usually results when a motor or mixed nerve is so injured that impulses can no longer be carried. The accompanying muscle atrophy presents itself within a relatively short period of time. In the case here presented this atrophy was very noticeable within 4 weeks from the onset of symptoms. When the impulses



8. PHOTOGRAPH 2 WEEKS POSTOPERATIVE, VOLAR ASPECT. THE DEFORMITY OF THE RING AND LITTLE FINGERS HAS DISAPPEARED AND THERE IS A RELATIVELY NORMAL RELATIONSHIP OF THE METACARPOPHALANGEAL AND INTERPHALANGEAL JOINTS.



9. DORSAL ASPECT. THE HYPEREXTENSION OF THE PROXIMAL PHALANGES OF THE RING AND LITTLE FINGERS IS NO LONGER EVIDENT. THE ATROPHY OVER THE DORSAL INTEROSSEUS BETWEEN THE THUMB AND INDEX FINGER HAS REMAINED ABOUT THE SAME.

are interrupted there is degeneration of the distal portion of the peripheral nerve. If the interruption is long continued, the degeneration may reach such a point that little functional improvement will result even when anatomical continuity of the nerve is reestablished. Given sufficient time, muscle contractures will result. These may prove particularly resistant to therapy. To determine the site of injury to the ulnar nerve one cannot rely upon sensory changes but must depend for the most part on the loss of function of muscles supplied by the nerve.

The deformity that follows ulnar nerve palsy is characteristic and is referred to as a *clawhand*. This condition of the hand is a result of several factors. The lumbricales which normally flex the first phalanx and extend the last two phalanges are paralyzed, allowing the antagonistic muscles to act and thereby causing extension of the first phalanx and partial flexion of the last two phalanges. Another factor in producing this deformity is the paralysis and atrophy of the interossei.

The diagnosis in most instances is not difficult to make. X-rays of both elbow joints should always be taken before attempting any surgical procedure. Delay in operation once the diagnosis is made is considered inadvisable in that the longer one waits, the less likelihood there will be for obtaining the best possible results.

There is little benefit to be expected from conservative measures, and in our case the condition was aggravated by whirlpool therapy. Many operations have been suggested for treatment of this type of injury about the elbow joint, all the way from simple liberation of the nerve to transposition and corrective operations about the elbow joint. At operation one invariably finds the ulnar nerve to be swollen in the region of the ulnar groove. The nerve is usually bulbous and bound down by dense scar tissue. It would not seem, therefore, that simple liberation of the nerve from its bed would be the operation of choice, it being apparent that the likelihood of recurrence is probable. Likewise the danger of injuring the nerve while doing an arthroplasty makes one hesitate to accept such a combined procedure. Simple transposition to the front of the condyle is not in itself satisfactory because of the possibility of the nerve becoming adherent again by progressive changes about the elbow joint. Also it is not unlikely that a simply transposed nerve will eventually return to its original bed. The operation of choice is transposition of the nerve to the flexor surface of the elbow and placing it under the belly of the pronator teres muscle once the nerve has been freed from its bed. This operation is commonly referred to as a combination neurolysis and transposition. It consists of freeing the nerve as it runs toward the ulnar groove to the point where it disappears between the two heads of the flexor carpi ulnaris. After this has been accomplished, it is a relatively simple procedure to transpose the nerve under the belly of the severed pronator teres muscle. This is accomplished by cutting across the muscle and resuturing it after the ulnar nerve has been placed beneath it.

CONCLUSIONS

1. A case of traumatic ulnar nerve palsy is presented.
2. Early neurolysis and transposition of the nerve beneath the belly of the pronator teres muscle is considered the operation of choice.

3. Arthroplasty about the elbow joint if necessary for restoration of function of the joint should not be performed at the time of the nerve operation but subsequent to it.

COMPLETE RUPTURE OF THE TENDO ACHILLIS ¹

REPORT OF A CASE

CHARLES W. McLAUGHLIN, JR.
Lieutenant Commander (MC) U. S. N. R.

Complete rupture of the tendo achillis is admittedly a rare injury, while partial rupture is relatively common. The majority of the reported cases of rupture of the tendo achillis have occurred as a result of athletic accidents. An increasing number of these injuries may be expected at a time when the majority of the young men in the country are undergoing a period of strenuous physical training in the armed forces.

CASE REPORT

F. S., a white enlisted man, 33 years of age, was admitted to the hospital on December 26, 1942, following an injury to his right ankle. The presenting complaint was inability to carry out plantar flexion of the right foot.

History.—The past history was entirely irrelevant. The patient was undergoing "boot" training and admitted no previous accident or serious illness.

Two hours before admission the patient was in a drill hall playing basketball. While shooting a basket he leaped into the air a distance of approximately 6 inches, landing on his toes with both limbs held in a rigid position of extension. As his toes struck the floor he distinctly heard something snap in his right ankle and had the sensation that something had given way. Pain was not a feature at that time, but on attempting to arise, motion of the right foot was found to be limited.

Immediate examination in a camp dispensary resulted in a diagnosis of traumatic rupture of the right tendo achillis, and the patient was sent into the hospital for treatment.

Examination.—On admission the patient was in no pain. He had not received any previous medication. Examination disclosed a rather heavy set young man 65 inches in height, weighing 185 pounds. The pertinent physical findings were limited entirely to the right ankle.

There was no swelling over the posterior aspect of the right ankle. Instead of the usual "bowstring" line of a normal tendo achillis, there was a distinct visible depression 2 inches in length along the line of the tendon about 1½ inches above the os calcis. On palpation of this depression, the examining fingers could reach the posterior surface of the tibia without encountering the usual resistance of an intact tendon. When the foot was manipulated into a position of plantar extension, voluntary plantar flexion could not be executed.

X-ray examination of the injured foot and ankle was negative for fracture or dislocation.

¹ Received for publication March 6, 1943.



Normal
1

Ruptured Achilles Tendon



Incision
2



3



Hematoma
4



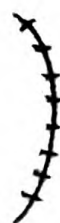
Sutures
5



Suture
6



Closure
7



Closed Incision
8

Clinical diagnosis.—A clinical diagnosis of traumatic rupture of the right tendo achillis was made, probably complete, and the limb prepared for surgery.

Operation.—Under spinal anesthesia a curved incision 12 cm. in length was made over the right tendo achillis (fig. 2). A large hematoma at once presented itself beneath the fascia, and after opening and evacuating this collection of blood, the site of the tendon rupture was visualized. The tendo achillis was completely divided 2 inches above its insertion into the os calcis and 1 inch below the termination of the belly of the gastrocnemius muscle. Both ends of the torn tendon for a distance of 1 cm. were markedly frayed and mangled, presenting an appearance as though the individual tendon fibers had been forcibly separated by a steel comb. This was especially marked on the proximal side of the rupture where several mattress sutures were loosely applied to appose the masses of separated fibers. One-half centimeter of each tendon end was excised, and by carrying the foot into a moderate degree of plantar flexion, satisfactory apposition was obtained. Repair was accomplished using one heavy silk suture of the hour-glass type (fig. 5), and a row of fine interrupted silk sutures placed around the circumference of the approximated tendon ends. The capsule of the tendon was closed with a running suture of fine chromic catgut, and the skin approximated with interrupted dermal sutures. A cast was applied incorporating the foot and leg, holding the former in a position of 60° plantar flexion.

Postoperative course.—The postoperative course was entirely uneventful. The original cast was removed 14 days after operation, the wound having healed by primary union. A second cast was applied with the foot placed at right angles to the leg. This cast was removed in 6 weeks and motion of the foot permitted. Union of the sutured tendon was satisfactory and a complete return of function was prompt. The patient returned to duty 9 weeks after his injury.

DISCUSSION

In 1935 Malbec (4) collected 86 cases of complete rupture of the tendo achillis in an extensive review of the literature. Reports of 6 additional cases recorded by American and English authors since this date have been reviewed.

Sudden muscular pull while participating in various forms of athletics have been responsible for most of the recorded injuries in young individuals. Trauma of a very minor nature occasionally has produced this type of injury in older persons. Galbraith (1) has reported an instance of ruptured tendo achillis in a 45-year-old man incident to stepping upon a stone with sudden tension on the tendon.

In many of the recorded cases the patient states that he has heard the tendon break or been conscious that something suddenly separated in the affected ankle. Immediate pain is usually a feature but was completely absent in the patient here reported.

There should be little difficulty in making an accurate clinical diagnosis in these patients with complete rupture seen soon after the injury. The history of injury, limitation of motion, and the depres-

sion along the course of the tendon together with an absence of the normal "bowstring" are all characteristic. Those patients who sustain incomplete rupture of the tendon or who report for examination days or weeks after the injury may offer much more difficult diagnostic problems.

The treatment of the condition is operative repair of the ruptured tendon. The site of the tear is usually found to be in the proximal portion of the tendon or at the junction of the tendon with the muscular portion of the gastrocnemius muscle. Marked fraying of the tendon at the site of separation is the rule and materially complicates the problem of satisfactory apposition. By flexing the leg on the thigh and carrying the foot into plantar flexion it is usually possible to approximate the divided ends without resort to tendon lengthening or fascial grafts. Silk is the suture material of choice for repair and the method of its employment in this case proved very satisfactory. Fixation in plaster should be maintained for a minimum of 6 weeks, but if the original cast holds the foot in plantar flexion, this position should be altered to one in which the foot is at right angles to the leg 2 weeks following surgery. Healing may be expected in approximately 2 months with a return to full activity in from 9 to 12 weeks.

SUMMARY

A case of complete rupture of the tendo achillis following an athletic injury is reported. The mechanism, diagnosis, and treatment are briefly discussed. It is suggested that this type of injury may be expected to occur more frequently as a result of the strenuous physical training program in the armed forces during the present emergency.

Acknowledgment.—The author wishes to express his appreciation to Ensign Myra A. Clark (NC), U. S. N., for the sketches accompanying this report.

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SYMPATHETIC OPHTHALMITIS¹**REPORT OF FOUR CASES**

GEORGE J. WIENMAN
Lieutenant (MC) U. S. N. R.

Sympathetic ophthalmitis has been defined by Duke-Elder as:

A specific bilateral inflammation of the entire uveal tract of unknown etiology, characterized clinically by an insidious onset, a progressive course with exacerbations, and usually disastrous termination, and pathologically by a nodular or diffuse infiltration of the uveal tract with lymphocytes and epithelioid cells, which almost invariably follows a perforating wound involving uveal tissue.

In practically all cases there is a history of a penetrating eye injury which usually, although not essentially, involves the region of the ciliary body. This type of injury causes approximately 65 percent of all cases in civilian practice, the remainder being due to ocular surgery, intra-ocular tumors, subconjunctival scleral ruptures and other infrequent conditions. In military practice penetrating wounds of the globe would probably be the predisposing cause in well over 90 percent.

The time factor in the causation of this disease is very important, as it influences prophylaxis and treatment. It is a well-known fact that sympathetic ophthalmitis may occur years after the initial eye injury, but at least 90 percent of the cases occur within a year. In fact, sympathetic ophthalmitis develops in between 2 weeks to 3 months after the injury in 80 percent of reports. Very rarely does it develop within the first 2 weeks.

The typical picture is somewhat as follows: An eye is injured with prolapse of uveal tissue. The injured eye remains injected and sensitive to light despite treatment, or it may appear to be improving satisfactorily. Then, after a variable number of weeks or months the well eye becomes reddened, lacrimates freely, and is sensitive to light. At the same time the patient notices that his vision is failing. Objectively, there is noticed a discolored iris, an irregular pupil which responds poorly to light and refuses to dilate with mydriatics or does so with difficulty, leaving some pigment behind on the anterior lens capsule. In a well-developed case gray-white or pigmented precipitates may be seen on the posterior corneal surface varying in size from those just visible to some half a millimeter or more in diameter. With progression, the pupil becomes completely fixed, membrane covers the lens, a secondary glaucoma may develop, and the eventual outcome is usually a shrunken, useless eye. However, the severity of the dis-

¹ Received for publication October 29, 1942.

case varies widely, some fortunate cases clearing in a short time with little or no visual loss. Unfortunately, these are exceptions; there is a great tendency toward relapse.

Diagnosis must be made clinically and it is of the greatest importance that it be made early, because only by early diagnosis can eyes be saved. Early clinical diagnosis is best made by careful examination with a slit lamp, but as that instrument is not available at smaller stations and aboard most ships, I shall stress only those features which can be elicited without that assistance, i. e.:

1. A history of a penetrating eye injury within the past year.
2. Persistent redness and irritation of the injured eye.
3. Decrease in vision of the uninjured eye along with a slight to marked redness, photophobia, and lacrimation.
4. The iris of the uninjured eye appears to be discolored, the pupil reacts sluggishly to light and will not dilate with a mydriatic or does so unevenly.
5. The presence of precipitates upon the posterior corneal surface.

The differential diagnosis clinically deals with two other conditions:

1. Bilateral iridocyclitis. There is usually no history of injury and in military practice it would present little difficulty.

2. The condition known as *sympathetic irritation*. This condition is by no means rare and is seen commonly in the case of foreign bodies of the cornea, with the fellow eye becoming sensitive to light, and having a slight ciliary injection. It is not unusual for this to occur following injury to an eye and it is stated that the vision in the uninjured eye may even diminish. However, careful examination reveals that the iris is clear, the pupil reacts well, and there are no precipitates. Diagnosis may require the use of the slit lamp, and in the case of an eye with greatly reduced vision it may even be advisable to remove the offending eye, although sympathetic irritation is not in itself of serious nature.

The prognosis in sympathetic ophthalmitis is difficult to determine from the literature because many of the cases reported as cured were of questionable diagnosis. Compilations of the latest statistical studies show roughly a 50-percent favorable outcome. Cases diagnosed early show some improvement on this figure.

In no other disease can it be said more truly that prophylaxis is *the* treatment. Many authorities have pointed out that delayed healing of eye wounds and retained foreign bodies are the common predisposing causes. Every effort should be made at the time of operation to make as thorough repair as possible. In those cases in which the injured eye is hopelessly lost there can be no legitimate reason for delay and it should be immediately removed. In those cases in which the injured eye has a chance of regaining useful vision, careful daily observation of the uninjured eye with daily vision acuity tests is of greatest importance. If despite all treatment the injured eye remains irritable, with lacrimation, photophobia, and ciliary injection, enucleation should be considered, particularly if the condition has

persisted for 2 weeks. Enucleation is the operation of choice as there have been many reports of sympathetic ophthalmitis developing after an evisceration, due apparently to retention of a small amount of uveal tissue.

Once the condition has developed the problem becomes much more serious. Here again the cases fall into two groups. In those with greatly reduced vision in the injured eye, and with a fair amount of vision remaining in the sympathizing eye, the best treatment is the immediate removal of the offending eye. In the second group are the advanced cases where the vision is about equal or the injured eye has the better acuity. In such cases it may be advisable to retain the eye, as it is not uncommon for the injured eye to have better vision than its partner, once the inflammation has subsided. From the medical standpoint the sheet anchor of treatment, as in other cases of iridocyclitis, is atropine. Every effort should be made to dilate the pupil and to keep it in that condition as long as the inflammation continues. Until recent years the rest of the treatment consisted for the most part of foreign-protein therapy and large doses of salicylates. Recently cases have been reported where sulfanilamide appeared to be of value.

CASE REPORTS ²

Case 1.—A Mexican, 36 years of age, was brought into the hospital in a highly intoxicated condition. His right eye had been incised with a knife in the upper, outer quadrant, causing a loss of vitreous and a prolapse of the ciliary body. The prolapsed uveal tissue was excised and a conjunctival flap pulled over. Post-operative care consisted of foreign-protein therapy and atropine. The patient left the hospital in 1 month with a vision of 10/200 in the injured eye, the eye still being slightly injected. He was seen twice a week following this, and on the fourth visit it was seen that both eyes were injected. Vision at this time was light perception in the right, 20/100 in the left. Immediate enucleation of the right eye was performed. Despite this the vision in the remaining eye fell rapidly to light perception and even this was soon lost. The pupil became occluded, and large precipitates were formed. Within 2 weeks he developed a psychosis and was transferred to a psychopathic ward.

Case 2.—The patient, a white male, 23 years of age, was struck in the right eye by a baseball, suffering a dislocation of his lens with subsequent cataract development. A loop extraction of the cataract was performed with some loss of vitreous. Convalescence was uneventful, the patient leaving the hospital in 3 weeks. He was instructed to return weekly, or at any time that either eye became inflamed. Three weeks later he came in complaining of redness of both eyes with a history of photophobia of four days' duration. He had failed to come in earlier because "I just thought I needed glasses." At that time his vision in the right eye was nil, vision in the left was 20/200. The left eye showed a 2-plus ciliary injection, marked photophobia, and lacrimation. The aqueous was clouded, the iris discolored with many small adhesions to the lens capsule, and there were many posterior corneal precipitates which could be seen with the

² These cases were seen in civilian practice.

naked eye. The right eye was immediately enucleated, atropine instilled in the left, and he was placed on sulfanilamide in relatively large doses. In addition he was given a foreign-protein therapy and calcium gluconate intravenously three times weekly for the first several months. He was kept on the ward for 1 year. On several occasions the sulfanilamide was stopped (he was kept on a maintenance dose of 30 gr. daily) and the eye flared up. When finally discharged, the eye was quiet with uncorrected vision of 20/20. This case is illuminating for several reasons: First, the fact that although seen relatively late with well-developed changes, a perfect end result was obtained; second, despite absence of prolapsed uveal tissue, sympathetic ophthalmitis did follow an operative procedure; third, the tendency to remission and exacerbation; fourth, the apparent therapeutic response to sulfanilamide, as cessation of its use caused at least two relapses; and lastly, the passage of a year before it could be felt that the disease was quiescent.

Case 3.—This colored male, 25 years of age, was struck in the right eye with a blackjack during a hold-up. At the time of admission the bulbar conjunctiva was greatly swollen and the anterior chamber filled with blood. No break in the continuity of the conjunctiva was seen at that time or subsequently. With bed rest and atropine the chamber cleared and the iris showed a defect in the upper nasal quadrant which was taken to be a traumatic inversion. It was impossible to see whether the sclera was ruptured or whether there was any prolapsed uveal tissue. The eye cleared rapidly and within a month he was discharged. Visual acuity in the right eye on discharge was limited to ability to count fingers at 4 feet; in the left eye it was 20/15. Two weeks later, upon a routine checkup of his vision, the best acuity that could be obtainable in the left eye was 20/70. Examination revealed a very early retinal detachment with a blurred and reddened optic disc. He was readmitted to the ward and observed for several days. The retinal detachment became more extensive, the disc was swollen and inflamed, and gray-white exudative patches were seen behind the retina. Meanwhile the injured eye showed no acute symptoms. It being apparent that we were dealing with a sympathetic ophthalmitis, enucleation of the right eye was done. During the procedure the eyeball ruptured and in the upper nasal quadrant matted, blackish tissue was found adherent to the under surface of the conjunctiva.

Despite all treatment the detachment of the left retina continued until almost the entire posterior portion was involved. However, the bulb remained pale, the pupil free. The vision became reduced to light perception. He was kept on his back for five months. The detachment eventually receded and when finally discharged, vision was 20/70 with some field constriction.

This case illustrates a rare type of sympathetic disease both from the etiological standpoint (a subconjunctival scleral rupture), and the clinical course (involving the posterior segment). Optic neuritis is not uncommon in this disease and may be partially responsible for visual loss in many cases. The initial symptom of sympathetic ophthalmitis may be a retinal detachment, as it was in this case. Here again we have a badly injured eye which was visually useless; if enucleation had been performed the disease could probably have been prevented.

Case 4.—This case is very similar to case 1. A Negro, age 30 years, came to the ward one night in a drunken condition. His right eye had been ruptured by a blow of the fist and uveal tissue was protruding from a ragged wound on the nasal side. Immediate evisceration was thought advisable but delayed because of the inebriation. The prolapsed uveal tissue was excised and a flap sutured over the wound. The following day the patient was ad-

vised to undergo an enucleation, but refused, and 4 days later signed a release and left the hospital. Visual acuity at that time was light perception in the right, 20/20 in the left. Three weeks later he returned with a full blown case of sympathetic ophthalmitis of severe degree. Vision in the left eye was then 20/200. Immediate enucleation of the right eye was performed and sulfanilamide therapy, foreign protein, and atropine administered. The eye appeared to be progressing well, vision improved to 20/60 (corrected), but he insisted upon going home for a day, remained a week without treatment, and upon return his vision was confined to counting fingers at 5 feet. Subsequent course was not followed, but, in view of patient's uncooperativeness, it can be assumed that the outcome was poor.

CONCLUSIONS

1. At least 17½ percent of badly injured eyes, if not removed, will lead to sympathetic ophthalmitis.
2. The most dangerous period after an eye injury is from the third week through the third month. The disease develops very rarely under 2 weeks.
3. The most important initial symptoms are diminution of vision, photophobia, and iridic involvement as evidenced by an irregular pupil, discolored iris, and by precipitates on the posterior corneal surface.
4. There is a great tendency for the disease to undergo remissions and exacerbations and no case can be considered quiescent before at least 1 year has elapsed.
5. Prognosis in advanced cases is poor. The only good treatment is prophylaxis.
6. Enucleation within 2 weeks after the injury is advisable.
7. Sulfanilamide and foreign-protein therapy appear to be of value, but continued dilatation of the pupil with a mydriatic is the greatest single factor in the treatment.

POWDERED SULFATHIAZOLE IN THE TREATMENT OF CONJUNCTIVITIS¹

JOHN H. SULZMAN
Lieutenant (MC) U. S. N. R.
and

CHARLES H. ELLIOTT, Jr.
Pharmacist's Mate, second class, U. S. N. R.

Medical officers at naval training stations are encountering eye infections due to contacts of barracks life. Similarly, with the expansion of personnel in offices, industrial plants, arsenals, and shipyards, an

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increased incidence of contagious and infectious eye diseases has also been prevalent in civilian medical practice.

Crowded living conditions have been conducive to an increase in upper respiratory infections. These frequently invade the conjunctiva secondarily by means of the lacrimal duct. Lighting facilities have been poor and limited, so that latent eyestrain has become manifest with its accompanying tearing and sensation of burning. The irritation produced has brought about eye rubbing, thus conveying organisms from the fingers to the eyes, producing lid and conjunctival infections.

Combined with the above considerations, it is factual that the therapeutic armamentarium of the average medical officer called upon to do eye work, is usually limited to boric acid solution, argyrol, zinc sulfate, and yellow mercuric oxide ointment. Their use has been productive of more or less hit-and-miss results. In general there has been a tendency to consider the whole subject of conjunctivitis with the resigned feeling that the condition is self-limited and will probably subside within a few days, regardless of the kind of treatment prescribed.

Perhaps it is well at this point to mention that not every case of redness of the conjunctiva is caused by infection. The irritation caused by the exceedingly minute corneal foreign body, the corneal abrasion discovered only by instilling 1 percent fluorescein, the conjunctival congestion caused by episcleritis, tenonitis, phlyctenule, allergy, or actinic rays, or that produced from an accompanying chronic infection of the lacrimal sac, or from one of the exanthemata, should be excluded from the list of infectious causes of conjunctivitis.

Textbooks of ophthalmology agree that the bacteriologic etiology of conjunctivitis is not entirely settled. Organisms have been difficult to find in smears taken from the conjunctiva. Also, as has been the case in ophthalmic pathology, one must have special training in ophthalmic bacteriology before the varied phases of this subject can be appreciated.

The confused bacteriologic aspect has been well exemplified by the infection known clinically as angular conjunctivitis, caused by the *Haemophilus lacunatus* (diplobacillus of Morax-Axenfeld). Zinc sulfate is claimed to be specific for this condition, whereas the ocular saprophytes, such as *Corynebacterium pseudodiphthericum* and *C. xerose*, found in clinically negative conjunctivae require no treatment.

Again, it should be emphasized that, more often than not, bacteria cannot be identified in smears taken from cases of clinical conjunctivitis. It should be borne in mind that some of these cases are due to refractive errors, or are secondary to acute rhinitis, and a virus conjunctivitis may be present without demonstrable organisms. For this latter reason, probably every case of conjunctivitis should have an

examination made of the nose, and treatment instituted to relieve nasal congestion if it is present.

This therapeutic insufficiency prompted us to seek other and more satisfactory curative agents. The use of 5 percent sodium sulfathiazole sesquihydrate, and the commercial 5 percent sulfathiazole ointment produced none too encouraging results. As a logical sequence we experimented with powdered sulfathiazole. The results are noted in the tabulated summary below.

We started by taking smears in conjunctivitis cases regardless of clinical appearance or duration of the infection, or a history of previous treatment. Studies of these smears yielded evidence of a variety of types of pathogenic and saprophytic organisms. In many cases, pus cells without bacteria were reported. No one type of organism was found to be predominant. In this experiment only one case of purulent conjunctivitis caused by gonococci was found, and this case was not included in the report, because the contagious nature of the condition required transfer to a naval hospital.

In the use of powdered sulfathiazole locally on the acutely inflamed conjunctiva, there was considerable irritation and pain. To circumvent this, we instilled 1 percent pontocaine hydrochloride. This routine usually eliminated local discomfort, although occasionally a patient would admit a slight burning sensation. Some complained of a transient blurring of vision caused by a film produced from the powder and lacrimal secretion. No other untoward reactions were found.

We soon discovered that the most practicable way of applying the powder was by the use of a small spoon, such as is used in otology for the removal of cerumen. The convex aspect of the instrument was used in spreading the powder evenly along the inferior conjunctival cul-de-sac.

In all, 167 cases were studied, and these were divided into 2 groups, as shown in table 1. Cases were treated once a day, and no treatment was prescribed between visits to the dispensary. Patients were cautioned not to remove the paste formed when tears mixed with the powder, in order to maintain contact of the drug with the inflamed conjunctiva as long as possible.

TABLE 1.—*Summary of treatments*

Drugs used	Number of cases	Average duration (days)
Argyrol or zinc sulfate.....	123	7
Powdered sulfathiazole.....	44	2

From the tabulated results it will be noted that the average duration of the cases treated with powdered sulfathiazole was 2 days, in-

stead of the usual 7 days. Absence from duty because of conjunctivitis has been materially reduced. The danger of spread of the infection has been lessened. Not the least important of the results of this treatment has been that the overtaxed clinical facilities of the dispensary have been relieved to some extent.

SUMMARY

The problem of clinical conjunctivitis has been briefly reviewed. Powdered sulfathiazole has been shown as definitely shortening the course of the infection. The facility with which this treatment can be employed, and the generally universal distribution of the drug at present, recommend its use.

Acknowledgment.—We wish to express our appreciation to Lt. Comdr. H. K. Russell (MC), U. S. N. R., for his cooperation in the laboratory phase of this investigation. Much further help and guidance in preparing this paper has been given by Lt. Comdr. L. A. Shifrin (MC), U. S. N. R.

ACUTE HEMOLYTIC ANEMIA ASSOCIATED WITH LEUKEMOID REACTION FOLLOWING ADMINISTRATION OF SULFANILAMIDE ¹

HOLLIS K. RUSSELL

Lieutenant Commander (MC) U. S. N. R.

There have been many reports in the literature regarding the toxicity of sulfonamide drugs, and among various manifestations have been occasional examples of acute hemolytic anemia and leukemoid reactions. The present case illustrates both of these complications in the same patient.

CASE REPORT

W. B., a negro, age 19 years was admitted to the hospital complaining of abdominal pain. He had vomited once and had had five loose bowel movements during the preceding 24 hours. The temperature on admission was 102.6° F. Physical examination revealed a tense abdomen with some peri-umbilical tenderness. There was no tenderness, rigidity, or spasm in the right lower quadrant. Examination of the chest was negative. A few hours after admission the temperature reached 104° F. Roentgen examination of the chest was reported as negative. Urinalysis showed nothing abnormal and the admission blood count (given in detail in table 1) showed marked leukocytosis.

The day following admission the diarrhea had disappeared, and he had three formed movements. Physical examination at this time revealed no localized tenderness or rigidity of the abdomen. The patient was therefore

¹ Received for publication March 11, 1943.

transferred to the gastro-intestinal service. After the transfer he again developed upper abdominal pain with tenderness. A surgical consultant advised immediate operation for acute appendicitis. At the time of the operation the temperature was 104° F. A normal appearing appendix was removed through a right rectus incision. There was no evidence of peritonitis, and exploratory examination of the liver, gallbladder, pylorus and large bowel showed no abnormalities. Eight grams of sulfanilamide was placed in the abdomen.

TABLE 1.—Sequence of blood picture

Date	RBC million per cu. mm.	WBC thous. per cu. mm.	Hb. in gm.	Hematocrit.	Mean corp. vol.	Percent normoblasts	Percent reticulocytes	Icterus index	Urobilinogen in urine	Blood platelets	Moist prep.	Bl. time (sec.)	Coag. time (min.)	Differential WBC.										
														Myeloblast.	Pre-myelocyte	Myelocyte	Juvenile	Band forms	Mature neut.	Lymph.	Monocytes	Eosin.	Erythroblasts	Normoblasts
11-24-42	3.75	25,000	10.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11-27-42	3.75	23,250	10.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11-30-42	2.10	110,000	6.0	18	85	7	29	18	1-100	310,000	—	—	—	4	5	11	20	21	35	3	1	—	1	6
12-2-42 ¹	1.84	108,000	5.2	15.5	86	22	26	12	1-100	(²)	60	7	7	2	3	10	23	23	32	5	1	—	4	18
12-3-42	2.65	99,500	7.5	22	85	27	22	10	1-100	290,000	—	—	—	0	2	14	14	28	40	2	—	—	7	20
12-4-42	2.88	59,900	7.7	23	82	16	15	12	—	—	(²)	70	9	0	0	8	15	36	35	4	2	—	2	14
12-5-42	2.54	22,500	7.4	21	85	4	7	13	—	—	—	—	—	0	0	4	6	30	52	5	2	6	0	4
12-7-42	3.25	12,050	8.0	27	84	2	3.9	11	—	270,000	—	—	—	0	0	2	2	11	63	11	6	6	0	2
12-8-42	3.34	11,600	8.1	27	82	1	2.1	9	—	—	—	—	—	0	0	1	3	10	60	19	4	2	0	2
12-9-42	3.71	10,150	8.3	—	—	—	—	—	—	—	—	—	—	0	0	0	1	8	61	21	3	6	0	1

¹ Transfusion 500 cc. whole blood.

² No sickling.

Following the operation his temperature varied between 100° and 102° F. for 10 days, and on the third postoperative day he was given 1 gm. of sulfadiazine every 4 hours for 2 days. Other drugs which the patient received were morphine, codeine sulfate, and nembutal. None of these drugs has been known to produce this type of blood reaction.

On the eighth postoperative day, because of the unusual blood picture, a sternal biopsy was made by cutting a window through the cortex and curetting the marrow cavity. The results of this examination are given in table 2.

TABLE 2.—Sternal marrow differential

Myeloid cells:	Percent	Myeloid cells—Segmented forms—Continued:	Percent
Undifferentiated cells.....	1.0	Eosinophilic.....	1.3
Myeloblasts.....	1.1	Basophilic.....	1.1
Premyelocytes:		Total percent myeloid cells.....	31.8
Neutrophilic.....	3.0	Erythroid cells:	
Eosinophilic.....	1.0	Megaloblasts.....	3.5
Basophilic.....	.0	Erythroblasts.....	8.2
Myelocytes:		Normoblasts.....	53.8
Neutrophilic.....	5.9	Total percent erythroid cells.....	65.5
Eosinophilic.....	1.0	Megakaryocytes.....	1.1
Basophilic.....	1.0	Lymphocytes.....	1.2
Metamyelocytes:		Plasma cells.....	.4
Neutrophilic.....	8.2		
Eosinophilic.....	3.1		
Basophilic.....	1.1		
Segmented forms:			
Neutrophilic.....	3.0		2.7

On the tenth postoperative day a small amount of serum was evacuated from the abdominal wound. Two days later he was allowed out of bed and his further convalescence was uneventful.

Other laboratory tests performed were: Kahn, negative; blood N.P.N. 34 mg. per 100 cc.; sputum typing showed no pneumococci types 1 to 33, but pneumococci of a higher type were present; numerous examinations of the feces were negative for occult blood; feces examination 2 days after the operation showed ova of *Trichuris trichiura*; heterophil agglutination test was negative; a blood culture taken 3 days after the operation was reported as negative after 21 days incubation; fragility test, (patient) 0.44–0.28; (control) 0.42–0.30; qualitative Van den Bergh was reported as showing an indirect reaction.

SUMMARY

This patient did not receive any drugs aside from sulfonamides, which are known to be capable of producing either acute hemolytic anemia or a leukemoid reaction. A sternal biopsy was performed which excluded leukemia and was interpreted as indicating an acute hemolytic anemia.¹ The subsequent changes in the peripheral blood further substantiated the conclusions drawn from the marrow picture.

A case has been presented of a patient, who developed an acute hemolytic anemia associated with a leukemoid reaction in the peripheral blood, following the use of powdered sulfonamide in the abdomen. This raises the question as to whether any patient without definite peritoneal infection should receive intraperitoneal sulfonamide drugs.

MUMPS ENCEPHALITIS¹

REPORT OF 3 CASES

WILLIAM T. CARLETON
Lieutenant (MC) U. S. N. R.

The occurrence of mumps in the armed forces of the United States in World War I caused an appalling number of hospital days. In fact, it ranked third (1), behind venereal diseases and influenza. There are rarely any permanent disabilities from this disease, but the loss of manpower from sick days is a serious consideration. Mumps is now regarded as a systemic disease (2) rather than parotitis with spread to other organs. The complications occurring in males are orchitis, encephalitis, and pancreatitis. The recognition of orchitis needs very little discussion or comment except that the incidence among 40 sailors seen recently has been between 25 percent and 30 percent, a greater incidence than usually reported in the literature. The occurrence of encephalitis is reported to be 10 percent (3). The

¹ Received for publication February 11, 1943.

symptoms are often mild and fleeting, which partially explains why it is so frequently unrecognized as the virus involvement of the central nervous system. The occurrence of pancreatic involvement is usually easy to recognize when it follows the parotitis, but will undoubtedly cause a lot of trouble if it precedes it as it occasionally does.

The purpose of this communication is to draw attention to the relatively frequent encephalitis. The diagnosis of this condition is easy to make if it is constantly thought of when treating cases of mumps. The virus of mumps is known to be neurotropic and the presence of meningeal signs or of abnormal neurologic signs must be regarded as *prima facie* evidence of active central nervous system involvement. In some cases the spinal fluid may show a pleocytosis and be indistinguishable from that of poliomyelitis. In such cases, the history of exposure to mumps about 18 days previously, and the clinical course, may be the only diagnostic criteria. In other cases, the spinal fluid may not show any abnormalities, or at the most a few more lymphocytes than normal. It is only when this occurs in the absence of parotitis or when it precedes the parotitis that it is really a diagnostic problem. The usual picture is the development of signs and/or symptoms, with or without fever, during the period when the parotitis or orchitis is subsiding. There is no question in my mind that in many cases the mild signs and symptoms are not recognized as those of meningo-encephalitis. Permanent deafness is a rare sequela of mumps and this is due to virus neuritis of the auditory nerve. Vertigo may occur and persist for a long time and may eventually develop into a full-blown Ménière's syndrome (2). Of all the virus encephalitides, that due to mumps virus is probably the mildest. Permanent brain damage rarely occurs, but there is need of extensive follow-up study of those cases with symptoms of encephalitis.

The more common symptoms are headache, dizziness, nausea, drowsiness, backache, tinnitus, vertigo, vomiting, and paresthesias. Personality changes are common and should be recognized as an important symptom of encephalitis. Encephalitis should be suspected in any case of mumps which develops one or more of the above symptoms. Along with these symptoms, there may be a stiff neck, other signs of meningeal irritation, or varied neurologic signs, depending upon what part of the brain is involved. Mild involvement of the facial nerve has been reported among the commoner neurologic findings (4). In many of the milder cases there may not be any objective findings and in such cases, the diagnosis must be made on the clinical picture alone. Spinal puncture is not indicated as a diagnostic procedure unless there has been no concomitant parotitis or

orchitis. It should be done as a therapeutic measure in those cases where drowsiness, severe headache, or other signs of increased pressure are present. The following cases illustrate some of the symptoms and signs of encephalitis occurring during the course of mumps.

CASE REPORTS

Case 1.—The patient was a 22-year-old seaman, second class, who entered the hospital with mumps involving the left side. As this subsided, the other side became involved. After 5 days, the swellings had completely subsided and the temperature had been normal for 3 days. The following day, the patient complained of a severe headache; the temperature was 103° F., and the neck was rigid. Kernig's sign was absent. Blood counts were normal. It was thought at the time that the picture was that of mumps encephalitis but spinal puncture was not done. The following day the temperature was 100° F., the headache was greatly improved and no new signs or symptoms had appeared. The patient made an uneventful convalescence. This case represents a rather typical fleeting virus attack on the central nervous system, often unrecognized as such.

Case 2.—This patient was a 21-year-old gunner's mate, third class, who entered the hospital because of pain and swelling of the left side of his face, fever, and malaise. Examination showed a left parotitis; the temperature was 100.6° F. The following day the opposite side was swollen, and he complained of nausea, dizziness, headache, and deafness. These complaints became worse during the next 2 days and vomiting was provoked by the slightest motion of the head. Physical examination during these days showed a definite nystagmus to the right and a slight deafness in the right ear. The rest of the examination was negative. What he called dizziness was found to be true vertigo. An otologist saw the man and found no disease of the tympanum or middle ear. The temperature ran around 100° F. He had a rather typical labyrinthitis due to the mumps virus, occurring not as a complication, but as a part of a systemic disease. The symptoms slowly disappeared during the next 5 days, when he developed a left-sided orchitis completing the generalized nature of the mumps syndrome. Two weeks later, the nystagmus was gone but he still had some deafness. The laboratory findings were persistently normal.

Case 3.—The third patient was a 19-year-old seaman, second class, who entered with bilateral swelling of the parotids of 2 days duration. The temperature was 100.8° F., both parotid glands were moderately swollen and tender, and the right testicle was quite tender but not swollen. Neurologic examination was negative. On the third day, the right testicle was swollen and more tender, the temperature was 103° F., and he complained of headache. The following day, the orchitis was improved but his temperature was 104° F., headache was worse, he was confused and markedly drowsy and he complained of paresthesias of his legs. He became nauseated and vomited several times, and temperature rose to 104.2° F. He coughed frequently but raised no sputum, and repeated chest x-rays were negative. Neurologic examination showed equal pupils, miotic, and reacting very slowly. The fundi and optic discs appeared normal. There was no nystagmus or deafness. There was a partial right-sided facial weakness, which cleared up in 2 days. He was obviously drowsy but fully oriented. Because of the severe headache and drowsiness a

spinal puncture was done. There was a definite elevation of the cerebrospinal fluid pressure and 10 cc. were removed for analysis. The cell count was normal, as were the determinations of sugar, protein, colloidal gold and Kahn. He was treated expectantly and considered to have mumps encephalitis on the basis of the clinical picture alone. The temperature was intermittent for 4 days and became normal as his symptoms cleared. During the midst of this episode, he also complained of moderately severe left upper quadrant pain which was associated with tenderness but no spasm. This was accompanied by distressing gas and distention, which disappeared in 24 hours. It was believed that this represented a mild pancreatitis, but of course such a diagnosis could not be proved. On the ninth hospital day the temperature was normal and he was symptom-free. His convalescence was thereafter uneventful. At no time did the white blood count or differential vary from normal. This case represents a more severe form of the disease, with more pronounced neurologic signs and symptoms and with spinal puncture indicated. It should again be emphasized that mumps encephalitis is rarely severe and rarely leaves any permanent defects.

CONCLUSIONS

1. Mumps should be regarded as a systemic disease in which encephalitis occurs as a part (rather than as a complication) in approximately 10 percent of the cases.
2. The symptoms of the encephalitis are usually mild and of such a fleeting nature that its recognition is often missed. Permanent disability is very rare.
3. Spinal puncture is rarely indicated either as a diagnostic or as a therapeutic measure.
4. The importance of recognizing the symptoms as those of encephalitis is not so much for therapeutic reasons as for relieving the anxiety of the doctor. The occurrence of fever, headache, vertigo, personality changes, vomiting, etc., should not provoke undue alarm; rather, they should be regarded as symptoms likely to occur in mumps.
5. Because there is no well-studied follow-up group, knowledge of permanent brain damage is limited. It is advisable to record such findings in the health record for future reference.
6. The three cases presented illustrate many of the symptoms encountered when the virus involves the central nervous system.

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UNUSUAL NEOPLASM OF THE ANTRUM¹

A CASE REPORT

FRED HARBERT

Commander (MC) U. S. N.

W. H. S., white male, age 43 years, instructor, was admitted to the hospital, December 2, 1938. His chief complaints were lacrimation of right eye, soreness, and external swelling beside right side of nose; onset March 1938.

There was a history of chronic nasal obstruction since childhood. In 1931 submucous resection and removal of nasal polyps was done. Nasal aeration was relatively good until 1935 when he noticed a serous discharge from both nostrils and increasing nasal obstruction. Since the winter of 1937 he has had practically constant nasal discharge of mucus and mucopus. In June 1938 polyps were again removed from both sides of the nose but without relief of the lacrimation of the right eye or the swelling near the inner canthus.

He was first seen November 10, 1938, at which time a bulging of the inferior turbinate, middle meatus, and middle turbinate was noted on the right side. Washings of the right maxillary sinus showed profuse thick mucopus. Immediate hospitalization was advised but patient desired to await a vacation due in the near future. On November 29, 1938, he slipped on ice and wrenched his left shoulder producing a simple fracture of the clavicle. He states that no fall actually took place but that the fracture occurred solely because of righting efforts (pathologic fracture?). On December 2 he was admitted to the hospital for further study of his nasal condition and treatment of the fracture.

Examination at that time showed a small tender swelling just below the right inner canthus, epiphora, a bulging of the right lateral nasal wall toward the septum, and tender firm enlargement of the right second and third chondrosternal junctions. The latter had been noted only since the injury and had been attributed to it. Antrum puncture on the right side produced only profuse bleeding. The nasal mucosa of the left side was pale and boggy and covered with glairy secretion characteristic of allergic reaction.

X-ray of the sinuses revealed a smooth bulge of soft tissue from the medial aspect of the right antral wall extending both into the lumen of the antrum and ethmoid region. The right antral mucosa was thickened and cloudy, the left was hazy. The Kahn test was negative and examination was otherwise essentially negative except for several small mucoid polyps in the right middle meatus.

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December 8, 1938.—A biopsy of tissue just below the mucosa of the right anterior ethmoid region was taken. The tissue was very soft, grossly resembled lymphoid tissue, and was very vascular. The microscopic report showed the tumor to be made up of small, undifferentiated, hyperchromatic cells consisting chiefly of nuclei. X-ray of the chest and sternum was reported negative for evidence of metastasis.

December 15, 1938.—Under infra-orbital and greater-palatine-foramen block anesthesia supplemented by 4 percent topical cocaine anesthesia, the right antrum and ethmoid region was exposed by the Denker or transantral approach. A very large, soft, lobulated, gray-red tumor practically filled the antrum and extended into the ethmoid cells. The tumor had eroded the bony wall of the floor of the orbit and broken through into the soft tissue of the face at the site of the small tender swelling previously noted. After dissecting the tumor free from these areas the sites were electrocoagulated. The periosteum of the antrum was completely removed and the tumor, together with the entire lateral wall of the nose, was removed en masse. The remaining ethmoid cells were exenterated and all suspicious tissue excised or electrocoagulated.

January 2, 1939.—Convalescence was uneventful. Deep x-ray therapy was started. The microscopic report of the excised tumor submitted by Dr. Eugene A. Case was as follows:

The cells have deeply stained, rounded nuclei and very little cytoplasm. They vary in size, and vacuolation has occurred in a number of them. The arrangement in groups or nests is characteristic of carcinoma and as they do not differentiate morphologically, I believe that the diagnosis of undifferentiated carcinoma of the antrum is justified.

This diagnosis was concurred in by two other pathologists.

January 10, 1939.—For the past week he has had vague pains in the lumbar region. These became more severe and interfered with sleep. Biopsy of the granulating areas in the ethmoid region showed no malignancy.

January 26, 1939.—The pains in the back and in the right hand became steadily worse in spite of physiotherapy, salicylates, etc. Repeated x-rays of the entire spine, and medical and surgical consultations were reported negative for evidence of metastasis. Injections of procaine into painful regions failed to relieve pain.

February 3, 1939.—Condition became steadily worse. The slightest movements caused severe pain, especially those requiring flexion of the lumbar spine. Confined to bed.

February 10, 1939.—Both lower extremities became paralysed. Pain in the back abated. X-ray treatment discontinued. Had re-

ceived 6,720 roentgens which caused erythema and mild desquamation of the skin of the face.

February 12, 1939.—Developed painless retention of urine and obstipation without distention. The bladder was at the umbilicus with spontaneous overflow. Paralysis of the lower extremities was complete both for motor and sensory functions. Paresis of the right hand and forearm, involving mainly the distribution of the ulnar nerve, was increased.

February 22, 1939.—X-rays still failed to show evidence of metastasis to the spine. Considerable loss of weight and strength.

March 13, 1939.—Developed continuous overflow from bladder without retention. Bowel movements obtained by enema every other day. Cachexia developed rapidly. 1,400 roentgens delivered to the spine.

March 20, 1939.—Marked emaciation. Right hand was now functionless. Developed mental deterioration, hallucinations, and confusion.

March 30, 1939.—Expired with sharp terminal temperature rise.

AUTOPSY REPORT

Autopsy permission was restricted to examination of the spine. The tenth thoracic vertebra was found to contain a new growth which completely filled the cancellous spaces of the body and had broken through into the vertebral foramen, causing pressure on the dura. Careful examination of the spinal cord and its membranes showed no evidence of new growth. The cord symptoms apparently were due entirely to extradural pressure. A similar but lesser involvement of the first thoracic vertebra accounted for the paresis of the right hand. An x-ray picture of the excised tenth thoracic vertebra which contained this extensive metastasis showed excellent preservation of the bony trabeculae of the cancellous spaces of the body and this explained why antemortem x-rays failed to show the metastasis, since it could not be demonstrated roentgenologically even in the excised specimen. Careful examination of the right antrum and ethmoid region showed complete epithelization with a glistening, modified epithelium and no evidence of recurrence of the growth.

The pathological fracture of the clavicle and the enlargements of the second and third chondrosternal junctions noted before operation were probably due to metastases not demonstrated by x-ray. The short time interval (3 weeks) between the operation and the onset of symptoms due to metastasis to the spine, suggests that metastasis preceded operation, for it seems unlikely that the entire cycle of implantation, growth sufficient to fill the entire body of the vertebra, and rupture into the vertebral foramen would take place in such a short time.

COMMENT

The tendency of lung tumors to metastasize to the skeletal system is well known but few cases of such metastasis from antral malignancies have been reported. In fact, undifferentiated carcinoma of the antrum is very rare. Of 129 reported primary malignant tumors of the antrum, 82 were squamous cell epitheliomas, 9 were sarcoma, 4 lymphosarcoma, 9 fibrosarcoma, 1 osteosarcoma, 6 adenocarcinoma, 6 were undetermined, and in 13 cases of undoubted malignancy, histological examination was not made. A feature of this case was the great extension of the metastatic growth in the cancellous tissue of the vertebrae without destruction of the bony trabeculae, thus making x-ray diagnosis impossible.

CONTACT DERMATITIS FROM BLACK COTTON SOCKS¹

JOSEPH M. SHELTON

Lieutenant (MC) U. S. N. R.

and

FREDERICK W. BUSH

Lieutenant Commander (MC) U. S. N. R.

Contact dermatitis from the dye in men's socks is not a rare finding in civilian practice. However, it is of considerable importance when found to be due to the dye in socks issued to Navy recruits, since it may be considered a sufficient reason for medical survey.

CASE REPORT

T. D., an apprentice seaman, entered the naval service on November 6, 1942. Approximately 3 weeks later his feet began to "burn and sting." At this time he was detailed to duty in the mess hall. Within 3 days his feet became "blistered" and walking became almost impossible. He reported at sick call on December 2, 1942, and was admitted to the sickbay for treatment.

At that time he presented a confluent vesicular and bullous dermatitis involving both feet. The eruption was sharply confined to the areas covered by his shoes but did not involve the soles or the intertriginous skin.

It was felt that the causative agent was either his socks or shoes. Patch tests employing both moist and dry specimens of his black cotton socks were applied to the upper arm on December 2. No definite reaction was discernible at the end of 48 hours, but a marked delayed reaction appeared at both test sites during the next 48 hours. The response was frankly vesicular at the area covered by the square of moist sock.

On December 10, one of the socks was cut into small pieces, placed in a shallow dish, and sufficient water added to cover them. At the end of 24

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hours sufficient dye had been removed by the water to render it a dark purplish-black color.

Patch tests were then applied as follows:

1. Plain white gauze moistened with water.
2. White gauze moistened with the water-soluble dye.
3. Specimen of black sock used for dye extraction.

At the end of 48 hours a faint reaction was visible at areas 2 and 3. Area 1 showed nothing. During the next 48 hours the reactions at areas 2 and 3 became quite definite and circumscribed. It was noted that the response at



1. SUBSIDING CONTACT DERMATITIS FROM BLACK COTTON SOCKS. A FEW UNRUPTURED BULLAE CAN BE SEEN. NOTE THE TYPICAL DISTRIBUTION.

area 3 was definitely less intense than that noted previously when the sock material containing all its dye had been employed.

The foot eruption rapidly subsided with the use of potassium permanganate wet dressings (1:4500), followed by boric acid ointment when the vesicles were dry.

SUMMARY

1. A case of proved contact dermatitis from issued black cotton socks is reported.

2. The possibility of such a diagnosis must be considered in any case of dermatitis confined to the shoe area. This is particularly true when the intertriginous skin is not involved.

3. The occurrence of this eruption is evidently rare since it is the only one that has appeared at this station among over 7,000 recruits.

4. The importance of patch-testing patients with suspected contact dermatitis is illustrated by this case.

EXTENSIVE (60 PERCENT) BURN¹

REPORT OF CASE

STEPHEN J. DONOVAN

Lieutenant Commander (MC) U. S. N. R.

and

FRANCIS J. CARR, JR.

Commander (MC) U. S. N. R.

The patient, a Merchant Marine cook, age 31 years, was admitted to the Dispensary, United States Marine Corps Air Station, St. Thomas, V. I., on June 30, 1942, for severe burns.

He suffered these as a result of a torpedo attack on his ship June 27, 1942. He was blown overboard with the blast and remained in the water about 2½ hours. He was then rescued by one of the ship's boats and was at sea, without treatment other than morphine for pain, until the afternoon of June 30 when he was rescued from a nearby island by one of the planes from this base. The total length of time between the blast and arrival at the dispensary was 52 hours.

On admission, the patient was critically ill and suffering from shock. The burns were extensive, of second and third degree, involving the entire head and neck, the entire upper extremities, the entire back to the waist, anterior chest at the neck and in front of the shoulders, a band around the abdomen, backs of the legs and buttocks, a circular area around the ankles, and a patch at the patellar areas (fig. 1). From Berkow's chart of skin surface percentages, it is estimated that at least 60 percent of his body surface was burned.

While being debrided and cleansed with soap and water, he was treated for shock by the usual methods. The burned area was treated for 48 hours with a saturated solution of sulfadiazine in water. When the supply of this drug was exhausted the burns were treated with powdered sulfathiazole for about 2 days and then sulfathiazole in oil. Dressings were used with the solutions. In addition, the usual supportive adjuncts of sterile precautions, heat tent, cortical extract, plasma (3 vials daily), intravenous saline (1,000 cc. daily), and other parenteral fluids were used.

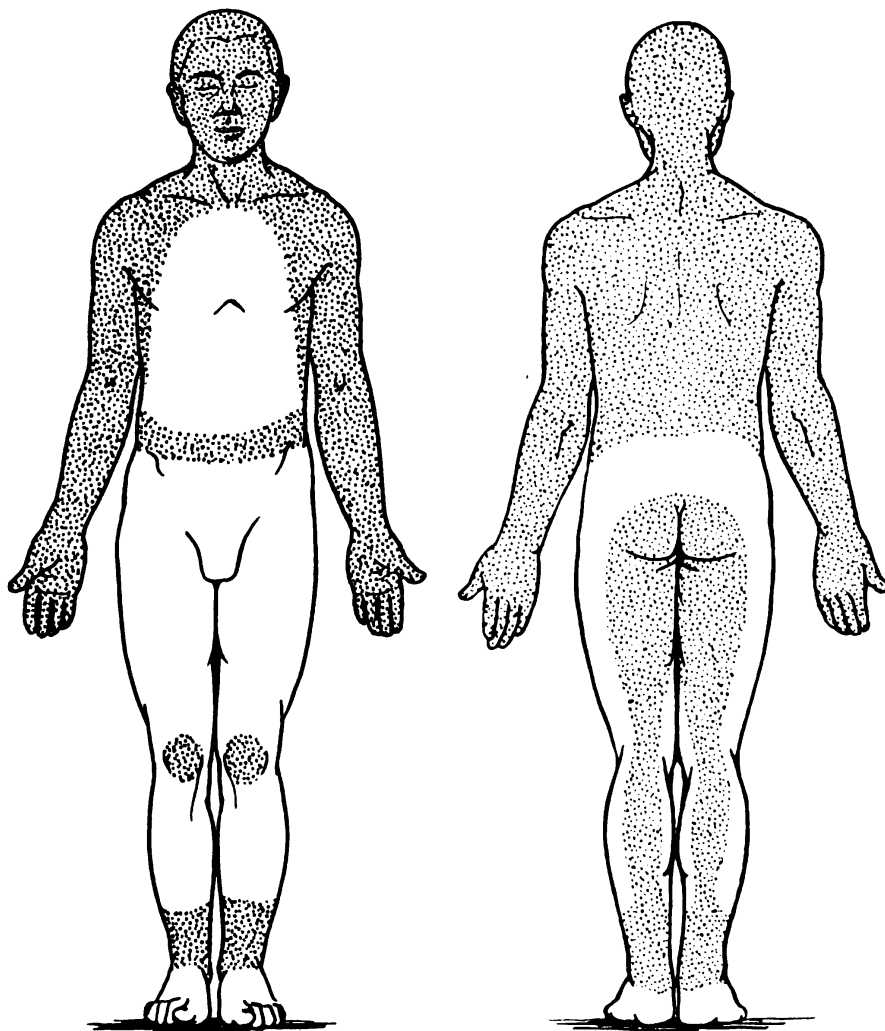
No skin grafting was needed and deformities were prevented by keeping the extremities in normal position with splints. Patient was discharged on August 12, 1942, completely well.

Two complications developed:

1. An extensive thrombophlebitis of the right saphenous vein from the knee to the groin, due to infection following an indwelling cannula. This cleared without incident.

¹ Received for publication September 4, 1942.

2. A limitation of motion of the right shoulder. This is believed to have been hurt at the time of the blast as each shoulder received the same degree of burn and the same treatment and there was no difficulty with the left shoulder. On physiotherapy it improved considerably but there was some limitation of motion in abduction at the time of his discharge.



1. DIAGRAM SHOWING EXTENT OF BURNS.

Observations.—1. The sulfadiazine in water treatment is not practical for such an extensive burn. The patient has to lie in a wet or damp bed all the time and it is very difficult to keep the dressings moist (despite a complicated multiple drip). The laundry changes are markedly increased and the nursing care involved increased beyond the facilities of a dispensary in this area if more than one case were under such treatment.

2. The veins used for injecting the plasma thrombosed and could not be used the next day. As only the veins on the dorsum of the feet, backs of the knees and thighs were available, this made each injection of parenteral fluids a surgical procedure.

3. The chest was not burned where he was wearing a cook's apron; again emphasizing the necessity of wearing clothing to protect against flash burns.

4. The sulfa drugs no doubt helped overcome the extensive infection. However, I do not believe they can be credited with saving this man's life, which should be attributed more to his cooperation, determination to live, and to the excellent nursing care given him by the nurses and corpsmen.

SUICIDE DUE TO PROMOTION DEPRESSION¹

A CASE REPORT

WILLIAM M. CASHMAN

Lieutenant Commander (MC) U. S. N. R.

Adolph Meyer invented the term "promotion depression," as defining a depressed state resulting from sudden and greatly increased responsibility. The following case comes under this category.

X, coppersmith, United States Navy, age 45 years, had been on duty on the U. S. S. ———, destroyer tender and repair ship, for 12 years. She had been cruising in European war-zone waters for 11 months when he was promoted to the warrant rank of carpenter. Six weeks later he committed suicide by jumping overboard.

After 1 month in his new rank and with his new responsibilities he had asked for a change of duty. Two witnesses, both his close friends, reported that after his promotion to warrant officer he became depressed and melancholic. Other factors may have entered, such as the fact that he had been off the ship only once in the preceding 10 months. His superior officers had every confidence in his ability to handle his new responsibilities. No physical troubles of any import were present. He was a married man, devoted to his family.

This is a brief report of a condition which is possibly not so very infrequent but which rarely appears in the literature. Here was an individual, overconscientious, reliable, of good personal habits, in love with his wife, and handling the responsibilities to which he was accustomed, in a thoroughly satisfactory manner. Given the promotion to which his evident abilities apparently entitled him, the result was tragedy.

The question is whether the examining medical officer can ever spot and prevent such an advancement; out of a field of work capably done, into feared, unknown, and unwanted honors. Can the examiner ask the questions: Do you want this promotion? Do you think you are capable of carrying on the responsibilities of this new rank?

¹ Received for publication January 29, 1943.

MEDICAL AND SURGICAL DEVICES

THE CONVERSION OF A NAVY STANDARD OPERATING TABLE INTO A FRACTURE TABLE¹

HARRY D. TEMPLETON

Captain (MC) U. S. N.

and

CARNES WEEKS

Lieutenant Commander (MC) U. S. N. R.

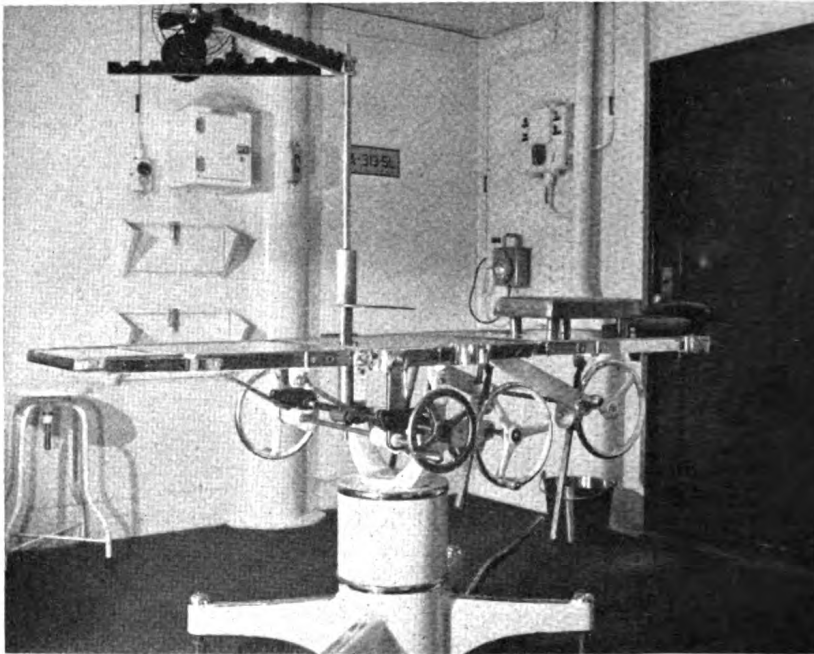
The fairly high percentage of fractures of the pelvis and lower extremities resulting from combat, presented us with the problem of deciding what method of reduction, fixation, and immobilization might be employed most expeditiously and successfully aboard ship. The plaster cast seems to offer the best solution, but the absence of a Hawley or other type of fracture table added complications and difficulties to this method of treatment.

It occurred to us that with the assistance of a good machinist, the Navy's standard operating table might be modified, by the addition of a few mechanical features, to serve a dual purpose and could be converted into a fracture table. Using those pictures and diagrams of the Hawley table as were available, a set of plans were drawn² which embodied the good points of that table and definitely improved on its weaker ones. All parts were manufactured from scrap metal in the machine shop.

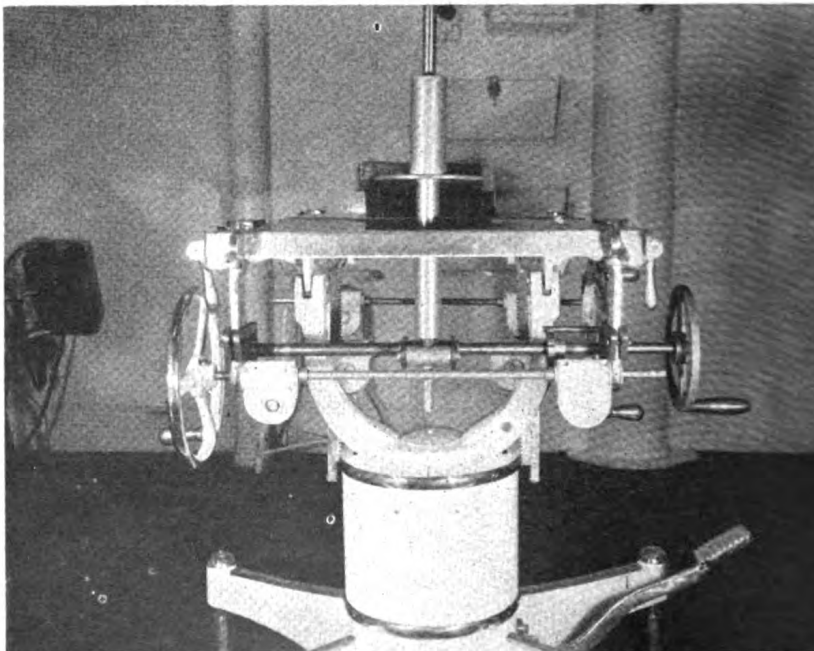
The accompanying photographs are self-explanatory. It was apparent that the lower part of the operating table could not be made to drop as in the Hawley table. It was planned to raise the patient by means of the sacral seat, the upper third of the body being supported by a small, movable, metal platform. The raising of the sacral seat was accomplished by incorporating a transverse bar, gears, and a perpendicular shaft supporting the seat. It was then a relatively simple matter to add the bar with the urethral groove and when well padded it provides the countertraction necessary in setting fractures of the lower extremity. Into this bar fits a slender perpendicular shaft which supports the two serrated arms used to provide suspension of the limbs when necessary.

¹ Received for publication March 31, 1943.

² It was found impracticable to reproduce the detailed line drawings submitted with this article. Those interested may secure copies by addressing the authors direct.—Editor.



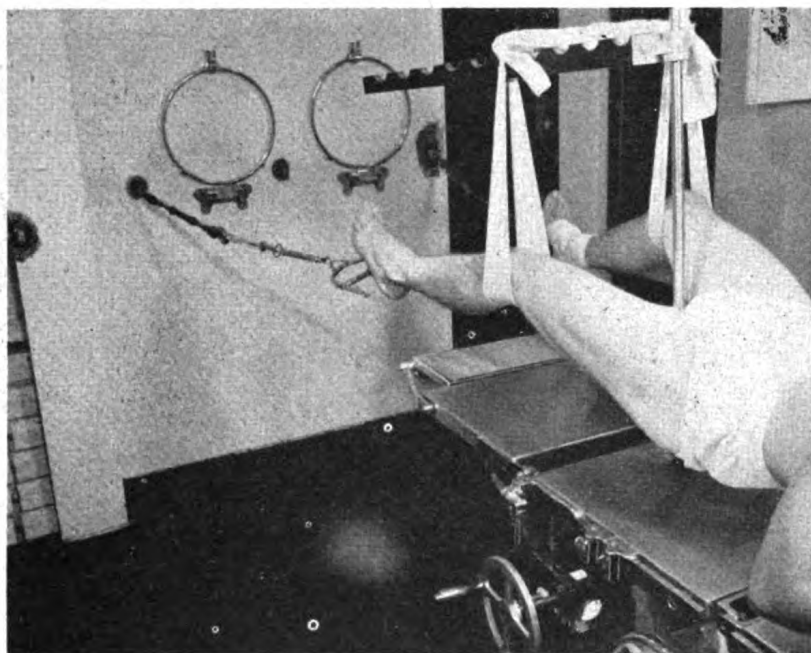
1. SHOWING NAVY STANDARD OPERATING TABLE CONVERTED INTO FRACTURE TABLE. THE SACRAL SEAT IS SHOWN RAISED; THE MOVABLE METAL PLATFORM FOR THE SUPPORT OF THE UPPER PART OF THE BODY IS AT RIGHT.



2. THE DISTAL LEAF OF THE TABLE HAS BEEN REMOVED TO REVEAL THE WORKING MECHANISM OF THE FRACTURE TABLE.

The advantages of the above modifications are obvious. We have an operating table and a fracture table in one.

The table can be lowered or raised 6 inches, which is possible with any operating table. The distance from the deck to the top of the table is 33 inches. The sacral seat raises the patient 4 inches above the top of the table; this provides ample room for the operator and his assistant to apply the body cast and manipulate the rolls of plaster. It will be noted in figure 4 that the lower third of the table top may be dropped, thus allowing easy access to the lower extremities.



3. SHOWING FOUR PAD EYES WELDED TO THE BULKHEAD. TRACTION ON THE FRACTURED EXTREMITY CAN BE OBTAINED BY SHORTENING THE TURNBUCKLE SECURED TO THE PAD EYE. THE FISH SCALE IS SEEN, REVEALING THE AMOUNT OF TRACTION APPLIED. MODERATE TRACTION IS APPLIED TO THE UNINJURED LEG BY MEANS OF TURNBUCKLE AND WIRE CABLE, SECURED BY BANGAGES TO ANKLE AND FOOT. OVERHEAD SUPPORT OF THE EXTREMITIES IS PROVIDED BY THE SERRATED ARMS.

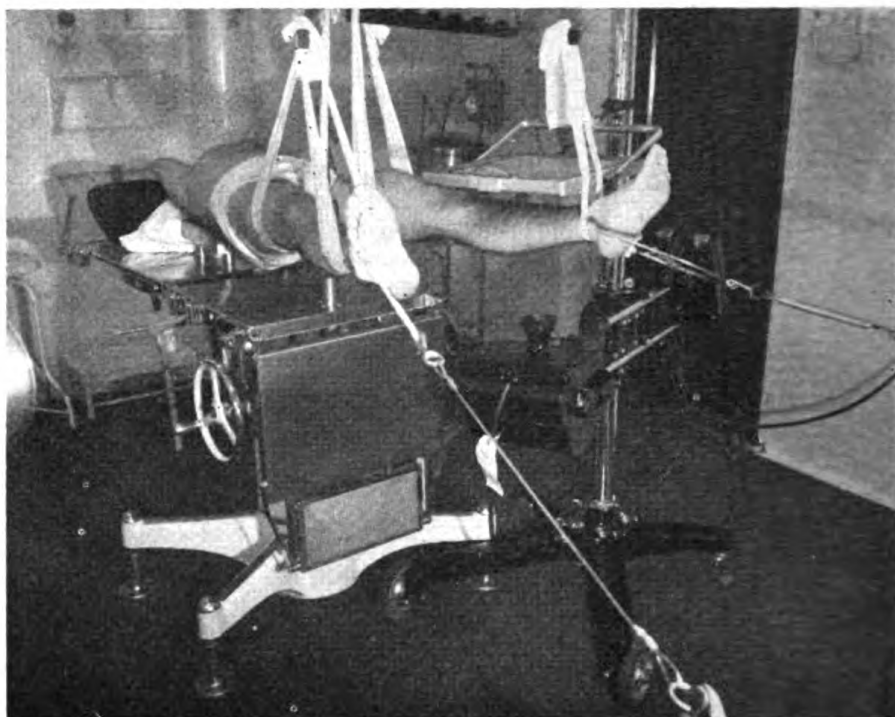
It is readily apparent that the long metal bars supporting the foot pieces, as seen in the Hawley table, are not present. Traction on the lower extremity by the use of that apparatus usually was most unsatisfactory. In the use of our modified table, skeletal or skin traction is obtained by utilizing one of the bulkheads in the operating room. Figure 3 shows skeletal traction in operation with a Kirschner wire through the os calcis. Four pad eyes have been welded to the bulkhead, to which traction lines can be secured. Since the table may be rotated 360°, many combinations of position may be obtained.

In figure 3 we see at the left a turnbuckle hooked to a pad eye, its sister hooks engaging a ring in a short piece of wire cable. This



cable has eye splices at either end and is kept on hand in varying lengths. The near eye splice engages a snap hook, which in turn hooks on to a small fish scale. This scale has a 40-pound maximum pull and will register quite accurately the amount of traction being applied to the extremity. This scale then hooks into the eyepiece of the Kirschner bow. This traction bow was manufactured aboard ship.

Traction on the sound leg is shown, with a similar turnbuckle and a length of wire cable secured by bandages to the foot and ankle.



4. SHOWING THE PORTABLE X-RAY AND FLUOROSCOPIC SCREEN IN POSITION. THE EASE OF ACCESS TO THE PATIENT FOR ANY PROCEDURE IS QUITE APPARENT.

With the use of this modified table and traction, it is a very simple matter to treat fractures of the lower extremity and pelvis. Figure 4 shows the use of the portable x-ray in obtaining fluoroscopic views of the fracture. The screen is a standard one and is secured to the x-ray machine by means of a simple bracket. By lowering the tube, it is a simple matter to slip the machine into place for an occasional view of the fracture. This arrangement will save much time and many x-ray films.

Acknowledgment.—We are greatly indebted to Chief Machinist's Mate, W. D. Sabo, U. S. N., and Chief Metalsmith E. I. Calfee, U. S. N., for the manufacture and installation of this equipment. Excellent detail drawings were made by Shipfitter, Third Class, A. Sibbald, U. S. N. It would have been impossible to accomplish this work aboard ship without their assistance.

A SUGGESTED METHOD FOR SIMULTANEOUS INTUBATION AND OXYGEN ADMINISTRATION IN AERIAL TRANSPORTATION¹

HOWARD R. BIERMAN
Lieutenant (MC) U. S. N. R.

Air transportation of patients is in its infancy. The adoption of aircraft for moving patients who are seriously ill raises certain problems. At the present time, the transportation by air of patients with severe injuries who are in shock or in the early postoperative stage, is limited by the nursing and therapeutic facilities available in air ambulances (1).

Air ambulances fly under ordinary circumstances at 2,000 to 3,000 feet. However, if unusual circumstances, such as enemy action, force the aircraft to fly at 10,000 feet or higher, two major problems become increasingly important. The first is anoxia. Although in the normal subject, exposure to altitudes of 10,000 to 15,000 feet is not critical, the patient who has received sulfonamides or certain other drugs may suffer severe grades of anoxia at these altitudes. The second problem is related to the expansion of intestinal gases at reduced outside pressures. The normal subject may suffer mild discomfort at these altitudes, but the expansion of intestinal gases to twice their original volume may spell disaster for the patient who has had a recent laparotomy or is bordering on shock.

Conditions in which abdominal distention should be minimized are:

1. Perforation of gastrointestinal tract:

- A. Traumatic:

1. Gunshot.
 2. Stab.
 3. Shrapnel.
 4. Crushing injuries.

- B. Nontraumatic:

1. Peptic ulcer.
 2. Incarcerated hernia.
 3. Intestinal obstruction.
 4. Typhoid fever.

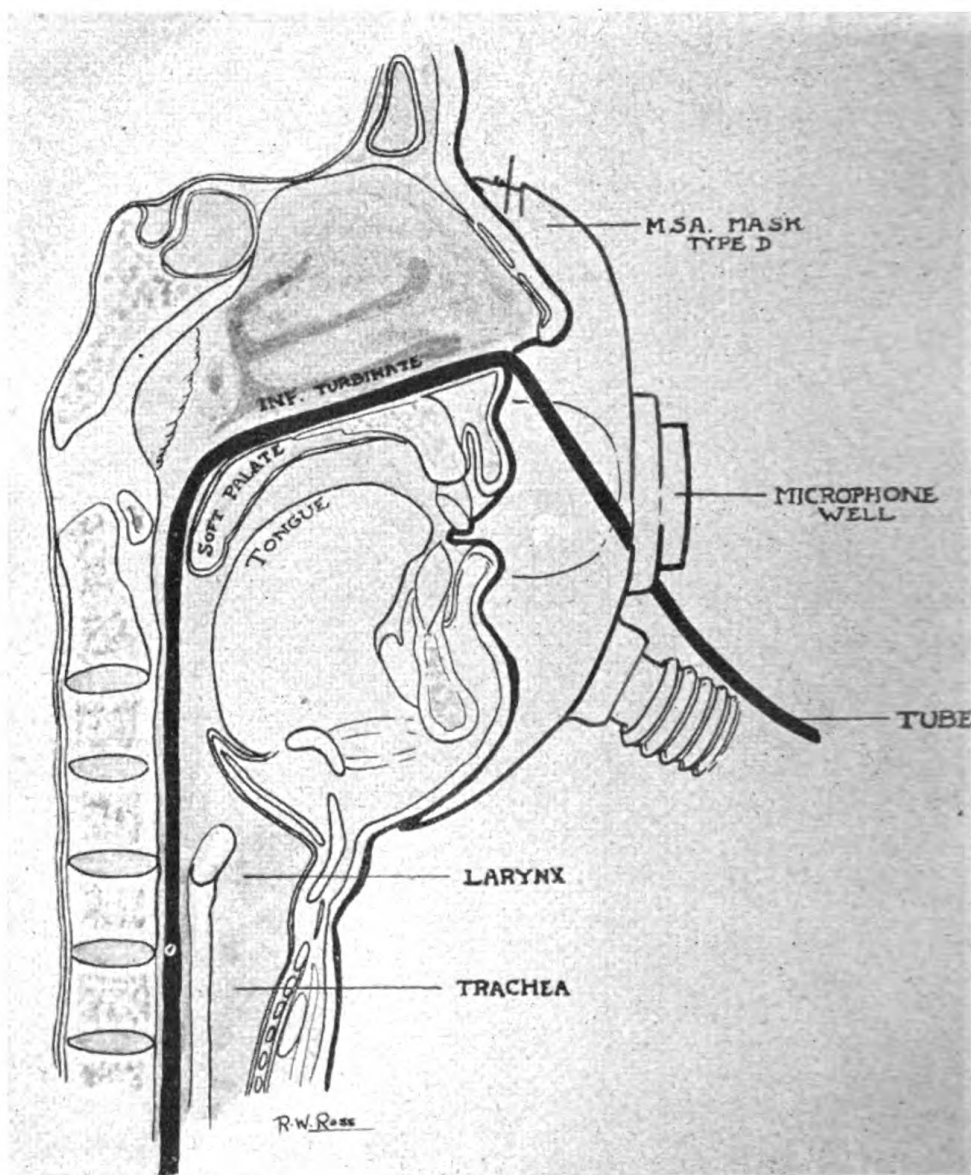
2. Shock.

3. Early postoperative period after laparotomy.

Intubation and suction of the stomach is a useful adjunct to therapy in the conditions listed above. But intubation is extremely difficult when the patient requires oxygen by mask. The following

¹ Received for publication March 29, 1943.

measure permits simultaneous intubation and administration of oxygen by full-face mask. The microphone in a MSA (type D) mask is removed, and a hemostat pushed through the hole in the microphone well which formerly held the microphone cord. A No. 14 French nasal tube may then be pulled back through the hole, following its

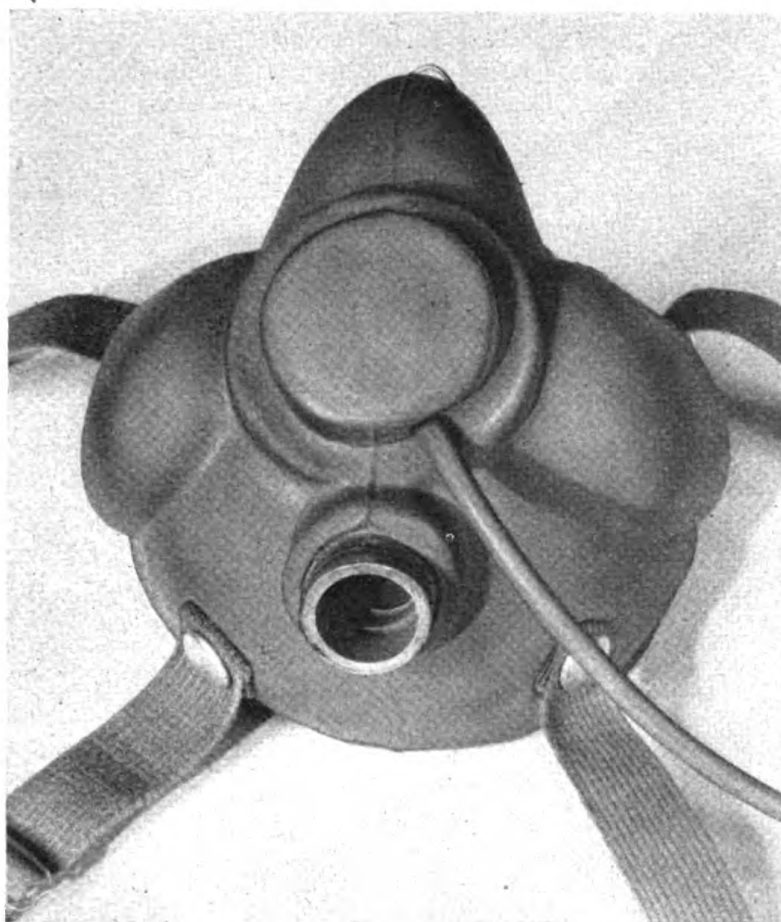


1. DIAGRAMMATIC DRAWING OF THE MASK AND TUBE IN PLACE WITH RELATION TO THE PATIENT.

introduction into the stomach (figs. 1 and 2). The present-day aircraft have ample suction lines which could easily be adapted for a No. 14 French ($\frac{3}{16}$ -inch diameter) tube. This connection could be simply of a jet variety. A bottle trap could be inserted between the mask and the source of suction, or a wide opening Venturi tube could

be installed to the outside slip stream. The passage of the nasal tube through the hole in the microphone well does not destroy the air-tight seal, and yet the tube remains patent. This allows the nasal tube to be anchored and prevents the tube from slipping in its position.

The possible uses for a nasal tube in patients in aircraft are many. It may be used for decompression of the upper gastrointestinal tract, and at the same time may be used to administer fluids, nourishment, or medication. In many cases the use of 100 percent oxygen may reduce abdominal distention (2) (3). Furthermore, oxygen tends to prevent nausea, and its use has been advocated in prevention or treatment of shock (4) (5).



2. FRONT VIEW OF MASK ILLUSTRATING NASAL TUBE OUTLET.

A well-grounded objection to the use of a full-face mask in ill patients is vomiting. Aspiration of vomitus from the well of an oronasal mask can be fatal. However, the use of a nasal Boothby mask with nasal suction, closes all but one nasal airway as a portal for oxygen. Furthermore, an unconscious patient requiring treatment for shock may breath through his mouth and thus reduce the effi-

ciency of nasal oxygen therapy. A nasal tube for oxygen would be advantageous, but the nose and posterior pharynx would be crowded with it and a tube for the stomach. It would necessitate a constant flow delivery of oxygen rather than a more economical demand type. The mean concentration of oxygen by nasal catheter probably does not exceed 50 percent and the positive pressure of the flow of oxygen might divert vomitus down the trachea.

Constant medical attention for ill patients aboard air ambulances is essential. If nausea or vomiting does occur, the mask should be removed immediately and the vomitus cleared. Such patients will do better if lying prone or on their side.

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DOUBLE-GROOVED MOUTHPIECE FOR ORAL RESPIRATION IN LOW AND HIGH BAROMETRIC BREATHING¹

A PRELIMINARY REPORT²

RAE D. PITTON

Commander (DC) U. S. N.

CARL A. SCHLACK

Lieutenant Commander (DC) U. S. N.

and

JOSEPH S. RESTARSKI

Lieutenant Commander (DC) U. S. N.

According to the present dental requirements for submarine training, edentulous personnel and those with many missing teeth, whether possessing replacements or not, are now rejected. The reason for this

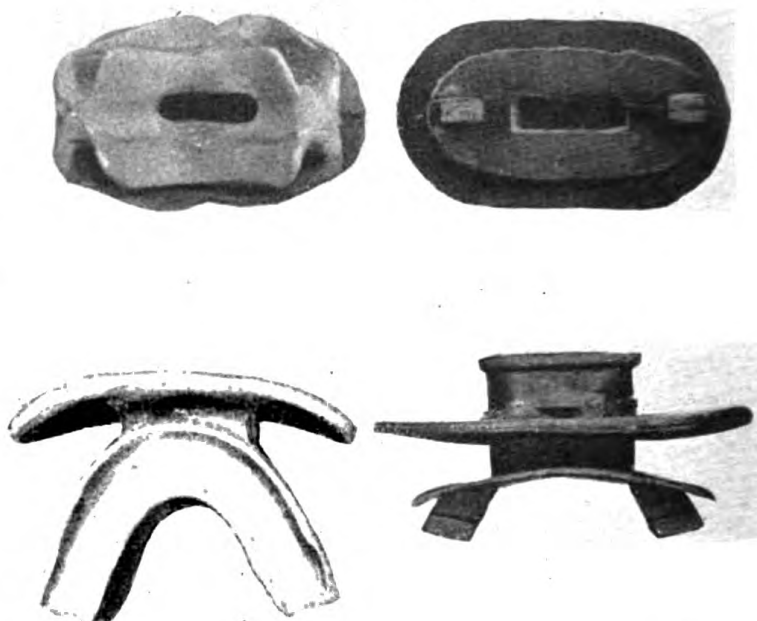
¹ From the Dental Research Department of the Naval Medical Research Institute and the U. S. Naval Dental School, National Naval Medical Center, Bethesda, Md.

² Received for publication April 8, 1943.

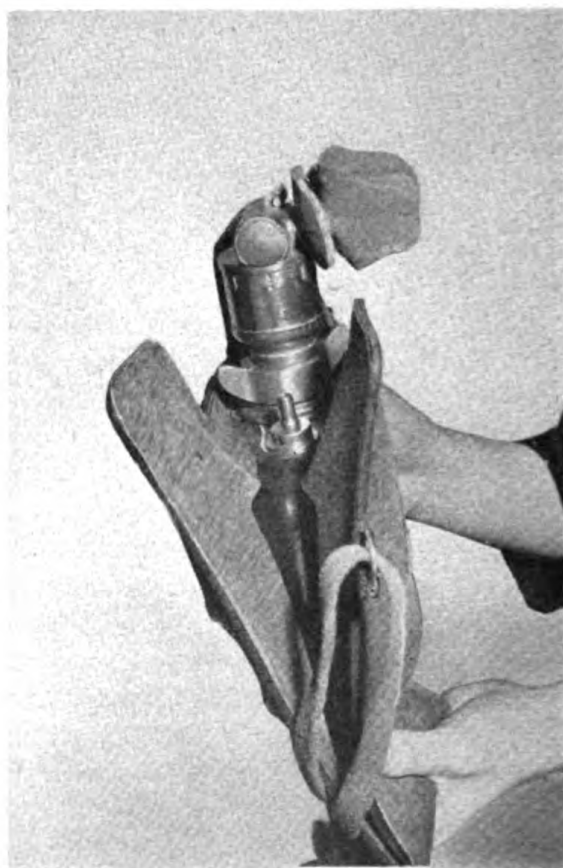
has been the questionable ability of such personnel to use most effectively the escape lung. It appears from observations outlined in a letter from the Commander Submarines, Atlantic Fleet, that such personnel can learn to use this apparatus. However, experiments here show that they have some difficulty. In those who have a few teeth present it seems to depend upon the position of the teeth as to whether they do or do not experience difficulty in holding the rubber mouthpiece. As long as some teeth are in opposition to each other in positions where the lateral lugs of the present mouthpiece may be securely grasped by the teeth, patients do not have much difficulty. The strength of the lip muscles may be increased by exercise in holding the present mouthpiece. However, the flexibility and design of the present mouthpiece seems to preclude firm and secure grasping even by well-exercised lips.

Since edentulous patients with appliances, as well as those possessing appliances replacing a great number of teeth, cannot as effectively use the escape lung with its present mouthpiece, it is felt that an alteration of the design of the mouthpiece may facilitate its more efficient use by the group under consideration. We have found that a mouthpiece can be designed for use by edentulous personnel, as well as by those with a full complement of teeth, and it is with that purpose in mind that a modification of the present rubber mouthpiece is submitted. A mouthpiece similar to the one designed here was constructed in 1931 or 1932 by F. M. Hobson shortly after the Momen lung was constructed in 1929. Little success was had with it at the time however, and only a few trials were made, resulting in continued use of the present mouthpiece. Improvements and modifications as here described employ basic prosthetic dental laws which apply determined averages.

The present mouthpiece contains two rubber lugs that are gripped between the wearer's teeth, and two rubber vertical fins which form a groove enclosing the upper and lower lips of the wearer (fig. 1, right). The modified rubber mouthpiece contains a gum block which fits over the edentulous ridges and replaces the two lugs. The gum block is grooved in such a way as to facilitate seating over the edentulous ridges. The rubber used for the modified mouthpiece is flexible enough to allow for compression and accurate fitting of the gum blocks over practically all edentulous ridges regardless of the intermaxillary distance or width and shape of the alveolar ridges. Its flexibility also allows its use by personnel with a full complement of teeth. Thus the mouthpiece may be used by personnel with any combination of teeth missing and present between these extremes (fig. 1, left).



1. OLD (PRESENT) MOUTHPIECE AT RIGHT. AUTHORS' MODIFICATION AT LEFT



2. AUTHORS' MOUTHPIECE ATTACHED TO ESCAPE LUNG.

Figure 3 shows the entire escape lung with an additional 5 pounds of weights being held without support of the straps, using the double-grooved modified rubber mouthpiece. The subject is edentulous with dentures removed. This cannot be done with the old mouthpiece.



3. LUNG AND 5-POUND WEIGHTS BEING HELD WITHOUT STRAPS BY EDENTULOUS JAWS.

An average arch form was used in shaping the gum blocks and an approach to the average intermaxillary distance (16 to 20 mm.) was chosen as the thickness of the rubber between the maxillary and mandibular ridges. The vertical flanges were placed to guide the gum block to proper seating on the alveolar ridges or dental arches, and help to prevent its displacement.

Theoretically the mouthpiece should also be instrumental in equalizing pressures via the eustachian tube and in that way help prevent damage to the tympanic membrane. Further experimentation will have to be conducted to determine whether the increase of intermaxillary distance, occasioned by the use of the mouthpiece in routine high and low pressure breathing, is sufficient to keep the eustachian tube opening from becoming closed by decrease in intermaxillary distance and muscle tension while teeth are in normal occlusion. One serious objec-

tion, however, is the interference with speech in communication while the appliance is worn.

It is felt that the application of the modified mouthpiece will permit lowering of dental standards with regard to numbers of teeth present. It must be emphasized, however, that oral and gingival infection, pyorrhea, many carious and abscessed teeth and gross deformities should be a cause for rejection. Arrangements are under way to try the mouthpiece in a great number of ascents at a submarine training school in order to determine its effectiveness.

A NEW EMERGENCY TRANSPORT SPLINT OF PLYFORMED WOOD

WENDELL G. SCOTT

Lieutenant Commander (MC) U. S. N. R.

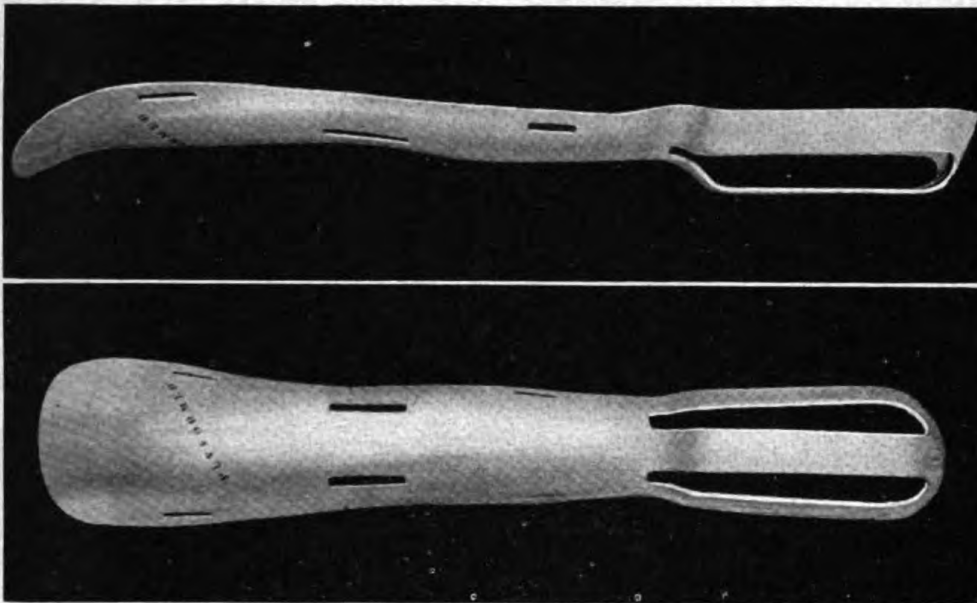
and

CHARLES O. EAMES

Early in 1942 work was started on the development of a new type of splint for the immediate treatment and transfer of patients with injuries to the lower extremities. The need for such an "emergency transport splint" was suggested by the reports of medical officers serving in the combat zones. In the "front line" zones the medical efforts are principally emergency measures for saving a man's life, alleviating pain, and preserving an injured part until the casualty can be evacuated to a base. In such combat zones the hospital corpsmen render a large part of the initial emergency treatments, which should always be reduced to the simplest, safest, and quickest methods. It was in the hope of simplifying the initial treatment and evacuation of men with lower extremity wounds under combat conditions that the "transport" splint was produced.

"Plyformed wood" is the copyrighted name given to wood veneers that are bonded together by a resin glue and "molded" or shaped to any form by a process involving heat and pressure. By this process it is possible to shape the bonded veneers into compound curves without straining or breaking the strips of veneer. For the purpose of description plyformed wood may be considered as a type of plywood that has been molded into a desired shape. It is light but very strong for its weight. The veneers and resin glue are not critical materials. This laminated wood does not warp as the adjacent strips of veneer are placed so that the grain in each runs at right angles to the other. These were the features that suggested the feasibility of using this material for a surgical splint.

Our object was to make a simple splint that could be applied quickly and efficiently by untrained personnel without causing additional damage to the injured part and yet provide adequate immobilization of the extremity with reasonable comfort to the patient. A series of molds and measurements was made of many lower extremities of various sizes and shapes. From a study of them it was possible to make a single posterior molded shell splint of plyformed wood that would support any lower extremity. It was made large enough to be used without removing the trousers or the heavy field shoe of the



1. EMERGENCY TRANSPORT SPLINT.

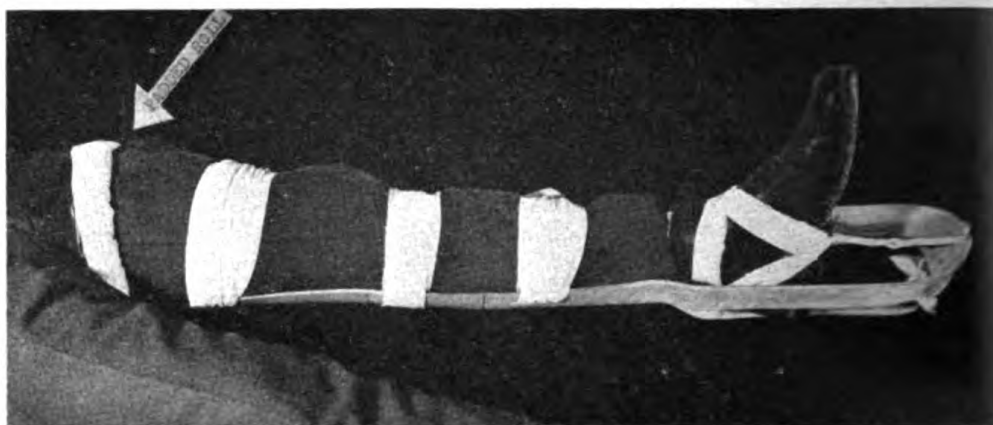
ABOVE—SIDE VIEW: The molded contour of the splint is designed to fit the shape of the posterior aspect of the buttocks, the thigh, the popliteal depression, the calf, and the heel support. The slots may be used to hold the cross tapes in place or to obtain countertraction.

BELOW—VIEWED FROM BACK: The splint is constructed in one piece, without joints, appendages, or "gadgets." It is finished in a smooth hard surface.

SPECIFICATIONS: Length over-all $42\frac{1}{2}$ inches; width at heel $5\frac{3}{4}$ inches, at hip 8 inches; depth for heel $3\frac{3}{4}$ inches, for thigh $1\frac{3}{4}$ inches; thickness of the veneers varies from $\frac{1}{8}$ to $\frac{1}{4}$ inch, depending on the need for strength. Weight $1\frac{1}{2}$ to $1\frac{3}{4}$ pounds.

casualty. The splint is fastened in place by means of cross tapes made from strips of 2-inch or 3-inch gauze bandage or even strips of cloth torn from a shirt. The proximal end is flared and convex so that the weight of the body anchors the splint against the ischial tuberosities. The squared base of the flared end together with the wide flat bottom of the heel rest prevents the splint from rolling side-wise. A stirrup was formed into the foot of the splint so that if traction is necessary, it can be applied either by wrapping a bandage

about the ankle in a double half hitch and after applying traction tying the free ends about the stirrup, or by threading a strip of bandage through a slit in the shoe just above the sole at the instep and bringing the free ends through the hole in the stirrup and fastening securely. Countertraction is obtained by fastening one end of a padded roll to the inside slot at the upper end of the splint and bringing the other end up against the crotch and over the grain and securing it to the opposite slot on the outside (fig. 2). Effective countertraction can be maintained by using a piece of 3-inch bandage tied in a hitch between the splint and patient's belt, as illustrated in figure 3.



2. SPLINT APPLIED USING PADDED ROLL FOR COUNTERTRACTION.

Immobilization is obtained by cross tapes of 3-inch bandage placed either through the slots or wrapped around the splint. A double half hitch is used about the ankle for securing traction. A safer method is to cut a slit in the uppers of the shoe just above the instep, run a piece of gauze through the slits, lace the shoe on the foot, apply traction, and then tie the free ends about the stirrup.

While figures 2 and 3 illustrate the use of the splint with traction, it is primarily intended to be used as a transport splint without any traction.

The photographs and specification contained in figures 1 to 3 illustrate the features that have been incorporated in the splint.

SUMMARY

1. This is a universal splint: (a) Fits either the right or left lower extremity. (b) Fits lower extremity of any size with trousers and shoes worn.

2. It is quickly and safely applied: Can be applied quickly by untrained personnel without risk of further injury due to application.

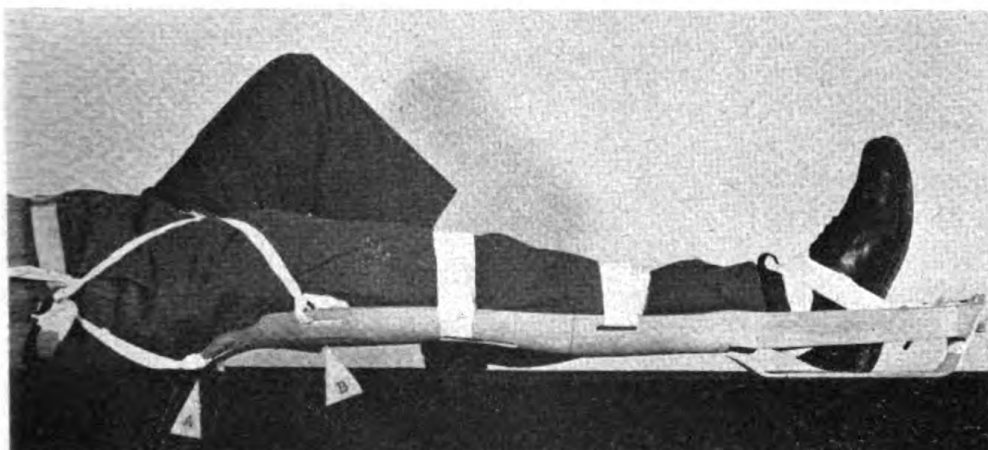
3. It provides immobilization for any fracture of the lower extremity: Fractures at any site can be immobilized from the foot to the hip.

4. Supports the entire lower extremity and protects it from extraneous movement: No part of the leg comes in direct contact with the

ground or stretcher, which eliminates certain imparted movements and jiggling to the leg during the rapid transfer and transportation of the casualty via stretcher, jeep, landing barge, airplane, etc.

5. "Padding" and "fitting" are practically eliminated, as the splint is molded to fit the contour of the leg.

6. Means for applying traction are available: While this splint is primarily for use in transporting the casualty, countertraction can be obtained by the physician when necessary. The safest method is to remove the shoe, make a slit through the uppers just above the



3. TEMPORARY TRACTION CAN BE OBTAINED BY USING THE COUNTERTRACTION HITCH DEvised BY CAPTAIN J. W. ELLIS (MC) U. S. NAVY.

The tape tied at slot B crosses over the thigh and is fastened to the belt on the left side. A second tape is fastened on the medial side of the splint in the slot opposite B and runs across the grain and is tied to the belt on the right side. Tapes from the uppermost slots at A are secured to their respective sides of the belt.

sole at the instep, thread a piece of bandage through it, lace the shoe on the foot, and apply traction to the ends of the bandage, which are then secured to the stirrup.

7. Simplicity: Constructed in one single piece. No adjustable joints or connections. No mechanical "gadgets" or features to deteriorate, lose, break, or get out of order. No appendages, hooks, or appliances.

8. It is easily carried and stored: The splints nest one within the other, just as spoons are stacked, making it easy to carry 6 to 12, and for the same reason they can be conveniently stored in a small space.

9. It is easily cleaned for prompt re-use.

10. It is translucent to x-rays: The splint can be left on during x-ray examinations.

11. It is light in weight: Entire splint weighs about 1½ pounds.

12. It is resilient and durable: Will receive shock without splintering or cracking. It is tough, durable, and strong.

13. It is waterproof and warp-proof: Can float for any length of time without its form or strength being affected. Will not warp.

14. It is constructed of noncritical materials: The supply of plywood veneers and resin glue is accessible.

A THOMAS SPLINT TRACTION BAR ¹

CLYDE R. FLORY

Commander (MC) U. S. N. R.

I am presenting a device for reducing fractures of the long bones of the extremities. It makes use of a simple principle employing the Thomas splint. It is readily made by the mechanics of almost any sea-going ship with materials usually on hand.

Upon approaching the African theater of hostilities last November, I was aware of the inadequacy of my equipment to meet a situation where statistics have shown that over 50 percent of topside casualties aboard a combatant ship consist of compound fractures. The desire to meet this situation fostered the thought of designing this type of traction device which our engineering department fabricated. It provides sufficient traction to allow manipulation and reduction of fractures of arms or legs and application of cast. It also serves splendidly for operative internal fixation, or as a means of continuous traction. It may be used as an aid to external fixation with devices of varied types now in use.

A half-ring Thomas splint may be used instead of the full ring where there is an operative procedure on the femur in the upper third. In case of fracture of the bones of the upper extremity the ring is placed snugly in the axillary space.

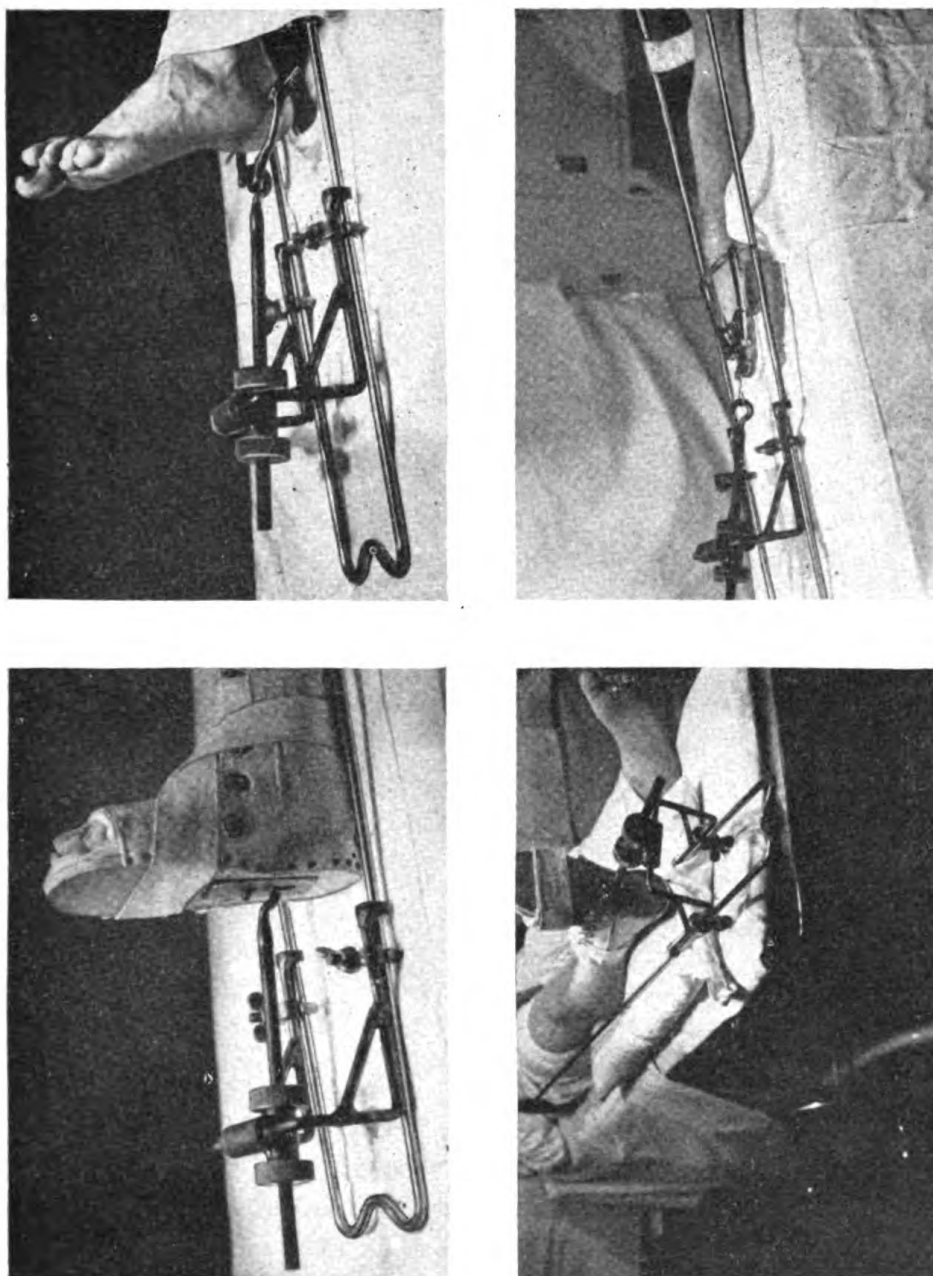
When the proper amount of traction is achieved, the two large milled nuts on the traction bar can be locked in a position so that the great toe-midpatellar-anterior superior spine line-up can be maintained, or the axis of rotation can be made to correspond with that of the well leg.

The yoke bar slides freely on the Thomas splint with slight constriction on the side bars of the splint as it is pushed toward the ring, facilitating its easy use for traction on the arm or forearm with a Kirschner bow and wire through the radius and ulna at the wrist, or the closed fist may be enclosed in a plaster of paris mitten with the hand grasping a padded suitcase holder.

The single, winged, thumb nut and flange on a T-bolt on each side of the traction bar is effective in securing it to the Thomas splint, allowing rigid traction to any desired degree on the draw bar.

¹ Received for publication May 1, 1943.

This apparatus permits an operative or manipulative procedure to be carried out with the patient on any flat surface, such as ward-room table, or operating table furnished combatant ships. The Hawley table or one of its modifications consumes precious space and is not carried afloat as standard equipment except on a hospital ship.



1. SHOWING VARIOUS METHODS OF APPLICATION OF TRACTION BAR.

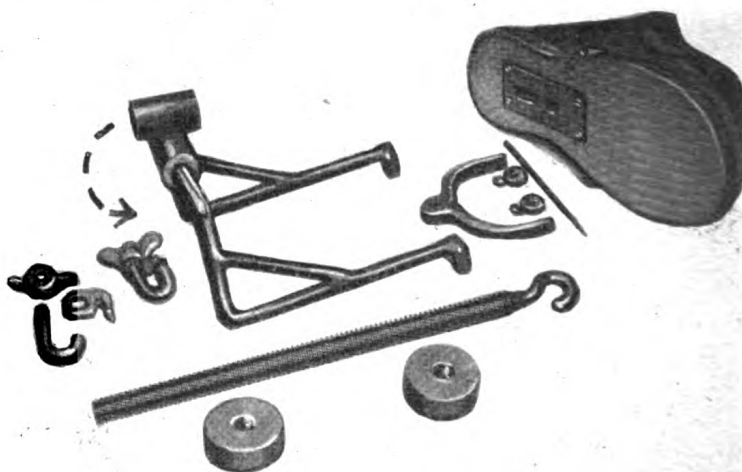
The axis of traction can be elevated or lowered more than an inch by swinging the rod holder around the bar saddle. For use of the shoe the line of traction is in the axis of the tibia and fibula and so it is best to place the draw sleeve on top of the crossbar. For use with the

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Steinmann pin through the os calcis, the axis of traction is lower and therefore the rod holder is allowed to rotate to its lower level.

It was first thought that a locking device to lock the traction yoke in its upper and lower level positions was desirable, just as in the inversion-eversion plane. But experience has shown that when sufficient traction is placed on the extremity it will not sag appreciably at the site of the fracture.

Aboard ship are numerous vent pipes, rods, rigid cable carriers, vented I-beams, at not a great height above the operating table, to afford the use of muslin bandage suspension of any parts of the body.

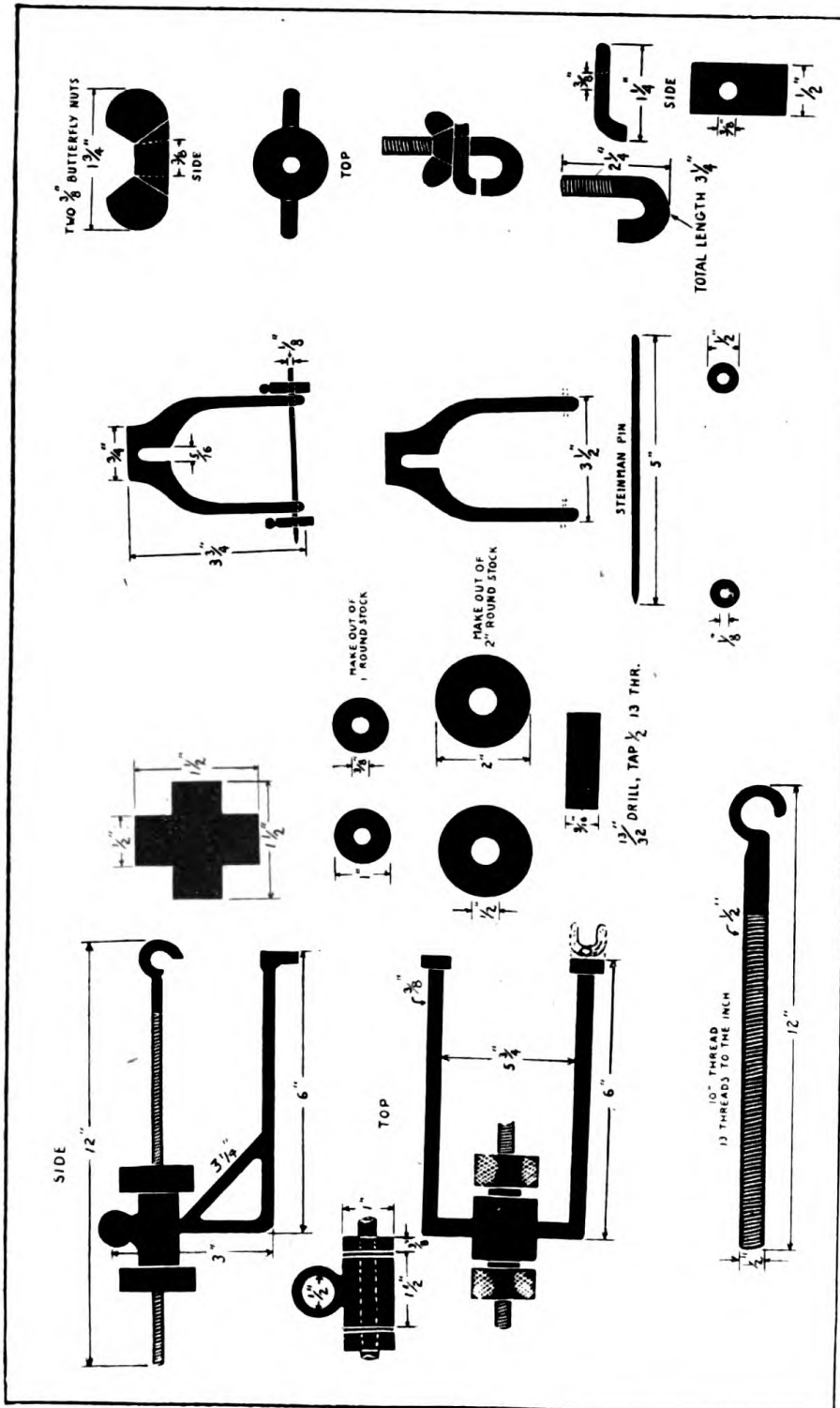


2. SHOWING THE FEW PARTS NECESSARY FOR USE WITH THOMAS SPLINT.

including both sound and splinted leg. Overhead crossbeams of wood can be constructed easily to meet the needs in other situations.

In carrying out an internal fixation procedure of the leg, or closed reduction, it has been found desirable to take an ordinary berthing mattress and double it on itself, placing it from the buttocks cephalward. Similarly a doubled mattress is placed from the buttocks downward. In removing the lower mattress or pulling it to the side under the well leg, the application of a cast is greatly facilitated. The turns of the cast material can be carried around the fractured arm or leg, with the leg maintained in traction, with very little inconvenience.

Where an internal fixation procedure is carried out, it is advantageous to employ the short 5-inch Steinmann pin through the os calcis, with the yoke and pin fixed by thumb-nut retaining washers. The curved end of the traction bar fits snugly into the traction yoke employing the Steinmann pin, or into the slot in the shoe so that there is no



3. CONSTRUCTION DETAILS.

lost motion or sidewise torque. The amount of rotation can be fixed and set with the two large milled nuts. The amount of traction available is adequate for any purpose.

The medical officers of this ship recently participated in an open reduction and internal fixation operation at one of our base hospitals in a foreign theater of war where neither any fracture instrument for open reduction nor any traction device was available. The patient, an enlisted man, had sustained a midfemur fracture, with muscle and periosteal interposition so that no union was present after 3 months. This apparatus was satisfactorily employed in securing adequate traction, enabling end-to-end approximation, fixation with a Lane type of small vitallium plate, and application of the cast.

The frame of the apparatus, the T-bolts and braces, are constructed of $\frac{3}{8}$ -inch iron bar throughout. One yard of stock will suffice. It is the same diameter as the usual Thomas splint. The cross yoke is constructed of 1- and 2-inch diameter brass rod stock with the centers drilled to $\frac{3}{8}$ -inch and $\frac{1}{2}$ -inch diameters. These $1\frac{1}{2}$ -inch pieces are welded at right angles to each other. The milled edge traction bar nuts are sawed from $1\frac{3}{4}$ -inch or 2-inch brass rod, drilled and threaded for the $\frac{1}{2}$ -inch traction bar.

This is a simple, practical, inexpensively constructed, piece of apparatus designed for use aboard ship, remote bases, hospitals, and shore stations, or where more refined equipment is not available.

Grateful acknowledgment is extended the Photographic Division of the Brooklyn Navy Yard for its excellent cooperation.

A SIMPLE METHOD FOR EXTREMITY IMMOBILIZATION ¹

HERSCHEL PENN

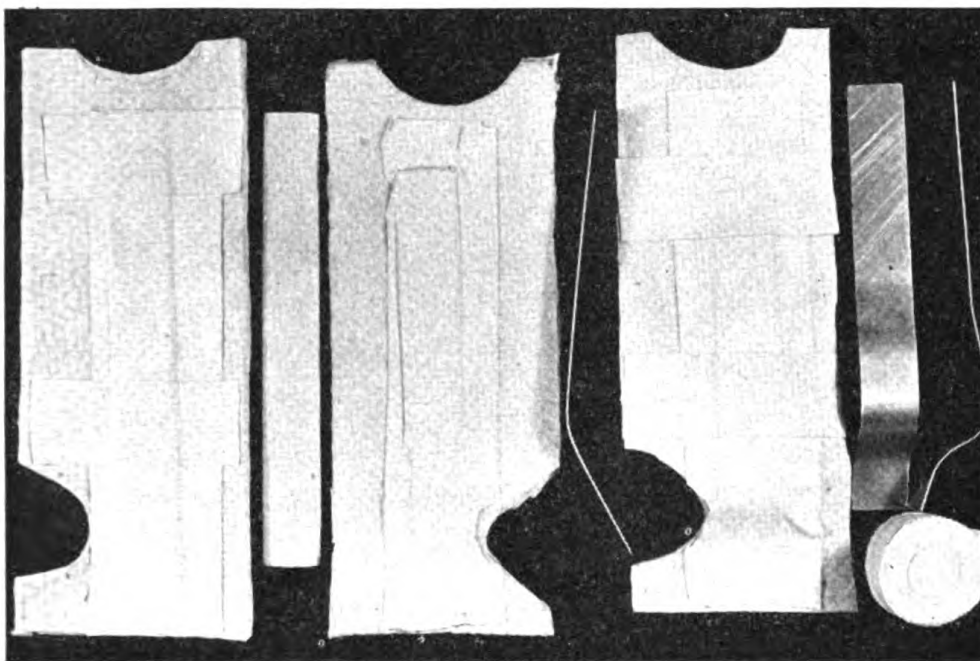
Lieutenant (MC) U. S. N. R.

It is agreed that the use of plaster of paris is the preferred method for splinting extremities. In many military activities however, this material is not available and for this reason a comfortable and efficient splint substitute was sought. Although the dimensions of the splint to be described are arbitrary, these figures were found to produce the most satisfactory universal size. In many activities metal-smith shops are available and the necessary strips of metal to be described may be easily obtained. If no metal is available wooden strips may be substituted, using basswood, balsa, or yucca wood. This does not produce as comfortable a splint however, as the cock-up and

¹ Received for publication March 1, 1943.

other positions may not be obtained. It is possible that wooden strips could be soaked in water and molded into the various positions.

The strips of metal or wood measure $1\frac{1}{4}$ by 10 inches, and the thickness of the aluminum used is 0.04 inch. Heavier metal would be satisfactory but should not be too heavy for proper molding. The felt is 13 by 5 inches, $\frac{1}{4}$ inch thick. A thumb notch is fashioned as well as a semicircular notch to facilitate flexion of the elbow. Although the splint described is for the forearm, other joints may be immobilized in a similar manner. The metal strips have been molded for treatment of fractures of phalanges and metacarpals as well as for reinforcing elastic bandage immobilization of the knee and ankle in cases of severe sprains.

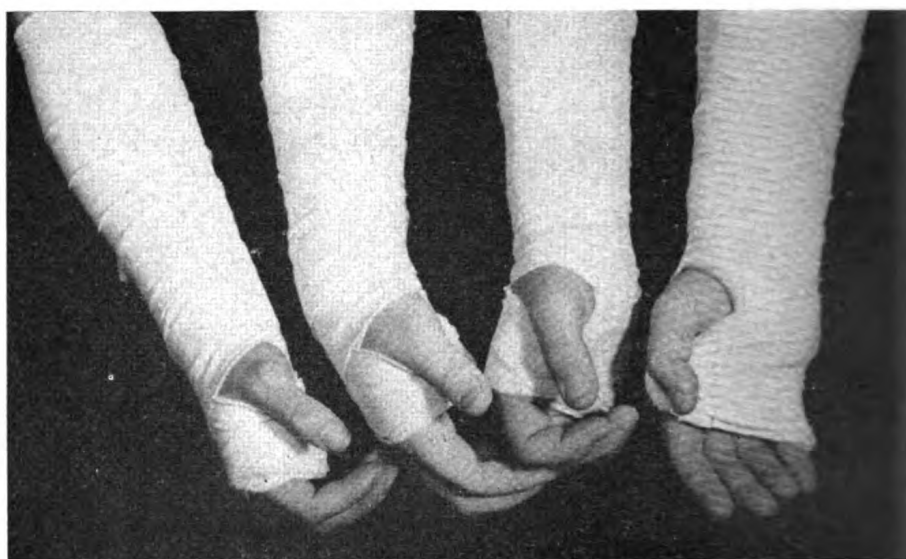


1. METAL AND WOOD SPLINTS APPLIED ON FELT AS FOREARM SPLINT.

In figure 1, the metal strips have been bent for cock-up and flexion positions. They are quickly attached to the felt by means of a wide strip of adhesive tape. Figure 2 demonstrates the splints applied in cock-up, flexion and neutral positions. The latter is reinforced with a wooden strip rather than metal. The splints are maintained in position by means of 2-inch elastic bandages, and have the added advantage of compensating for additional swelling because of the elasticity of the bandages, thus decreasing the danger of circulatory embarrassment.

The primary purpose of this splint is to facilitate the treatment of wrist fractures with little or no displacement, or of severe sprains. It may also be useful for temporary immobilization in the transportation

of more severe fractures, and, if no plaster is available, it could be used for permanent treatment of severe fractures following reduction. Its advantages are its comfort, the decreased danger of circulatory em-



2. SPLINTS APPLIED SHOWING VARIETY OF HAND POSITIONS.

barrassment, the simplicity of preparation and the availability of the necessary material.

A NEW NEEDLE HOLDER FOR PLASTIC SURGERY ¹

GEORGE V. WEBSTER

Lieutenant (MC) U. S. N. R.

The general operating instruments most used in plastic and reconstruction surgery include small rat-toothed forceps, small scissors, large and small scalpels, mosquito hemostats and some form of needle holder. The refined character of plastic work has led to the adoption of small instruments, tiny needles, and the finest of sutures and ligatures, all with the constant purpose of reducing trauma to its lowest possible level. With this in mind, it seems astonishing that, although a rather good variety of other small, well-adapted instruments are available, little attention has been paid to the constantly-used needle holder.

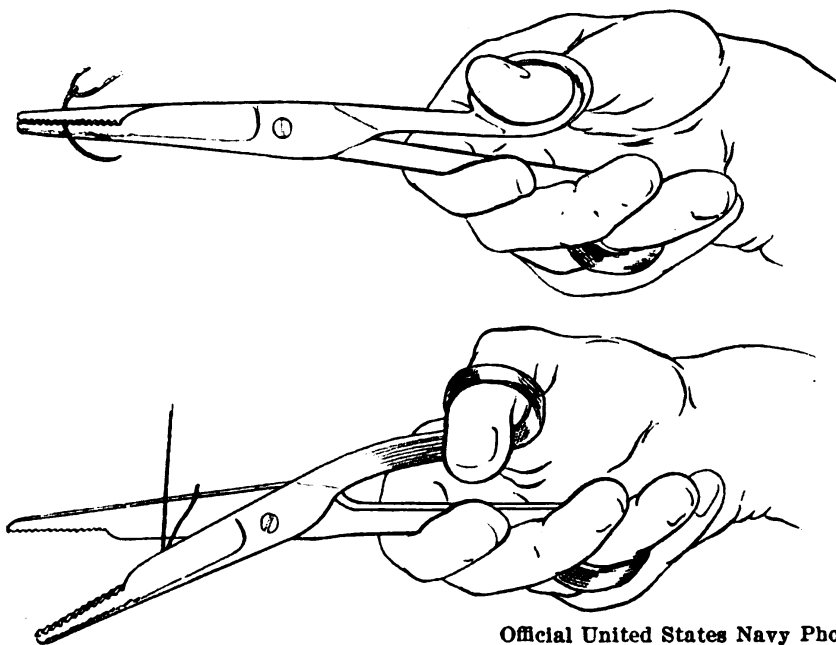
Large needle holders, which are designed for general abdominal or gynecological operating, have no place in plastic technic. The jaws would crush small needles, would fail to grasp a fine thread for tying,

¹ Received for publication April 28, 1943.

and the length of the instrument magnifies the radius of hand motion so as greatly to impair one's kinesthetic sense. The use of a standard hemostat to hold the needle or tie is crude and inefficient, for many motions are lost when the needle turns in the serrations which were not designed to hold it, or when the thread is cut by these same sharp serrations while tying, or similarly when the thread repeatedly catches in the sharp box hinge. The small needle holders, used in ophthalmic surgery, dental surgery, or other specialties, have numerous disadvantages when employed in general plastic work. Their grip is unfamiliar to men trained in general surgery and the spring and locking mechanisms are variable and often inefficient.

THE GILLIES NEEDLE HOLDER

A needle holder, designed by Sir Harold Gillies¹ specifically for plastic surgery, is in use in this country (fig. 1). Its special features include (a) a scissor grip, the thumb loop of which is shortened and enlarged to fit well down near the metacarpophalangeal joint of the



Official United States Navy Photograph

1. THE GILLIES NEEDLE HOLDER (REDRAWN FROM GILLIES' "PLASTIC SURGERY OF THE FACE," OXFORD, 1920) SHOWING THE SHORTENED THUMB LOOP, THE COARSELY SERRATED JAWS AND THE SCISSOR BLADES NEAR THE HINGE. NOTE ALSO THE RELATIVE SIZE OF THE INSTRUMENT, THE OPERATOR'S HAND AND THE NEEDLE AND SUTURE MATERIAL.

operator's thumb; (b) a small serrated and grooved tip designed for holding a needle or grasping a suture for tying knots; (c) a pair of scissor blades near the pivot, so placed that a suture may be cut with the same instrument which tied the knot.

¹ Gillies, H. D.: Plastic Surgery of the Face Based on Selected Cases of War Injuries of the Face, Including Burns. Oxford, 1920.

This instrument is well-liked by many plastic surgeons, and in the hands of those skilled in its use, it is an efficient instrument. There are, however, certain disadvantages of the Gillies needle holder which seem noteworthy to this author. In the first place it is a fairly large instrument and is therefore a longer lever than necessary, magnifying the tremor and natural error of precision movements of the operator's hand. Secondly, the radius of motion centers about the base of the fingers. Thus, pronation and supination in one plane, with only moderate variation, are the only "natural" or "handy" movements with this instrument. Finer movements in odd angles about the face or hands or in a deep wound, are often awkward. The scissor feature would seem at first to be an advantage, in that it saves extra motions of putting down the needle holder and picking up the scissors each time a suture is cut. This undoubtedly is true when working without assistance and on a flat surface where the protruding, needle-holding part of the jaws can have free motion. (It can be seen readily that these scissor jaws could not be used about the inner canthus of an eye or around the folds of a nostril, or between the fingers). But if one studies the motions used in placing a suture and tying with this instrument, it is apparent that upon completion of the tie, the end of the suture with the needle attached is in the operator's left hand, while the other end is in the grasp of the needle holder. Now, to cut this suture it is necessary to transfer the end from the needle holder to the left hand in order to hold the suture for cutting. These ends are usually not of equal length, so a second shift of position of the left hand is needed to grasp both ends of the suture. Then, after cutting, the short end must be disposed of before replacing the needle in the needle holder for the next suture. Since the short end is already held in the left hand, the left hand must move out of the field to dispose of the short end, then shift again to hold the needle for placing in the needle holder for the next suture.

Motion-study experts in industry agree² that it is more efficient to use two hands to make two motions simultaneously rather than using one hand and making them consecutively. In this case, if the suture had been held as it was when the knot was finished, a quick scissor cut by an assistant allows the operator to discard the short end by "wiping off" his needle holder with his right hand, while the left hand is holding the needle holder as it returns from the "wiping off" motion and he is then ready to place the next suture.

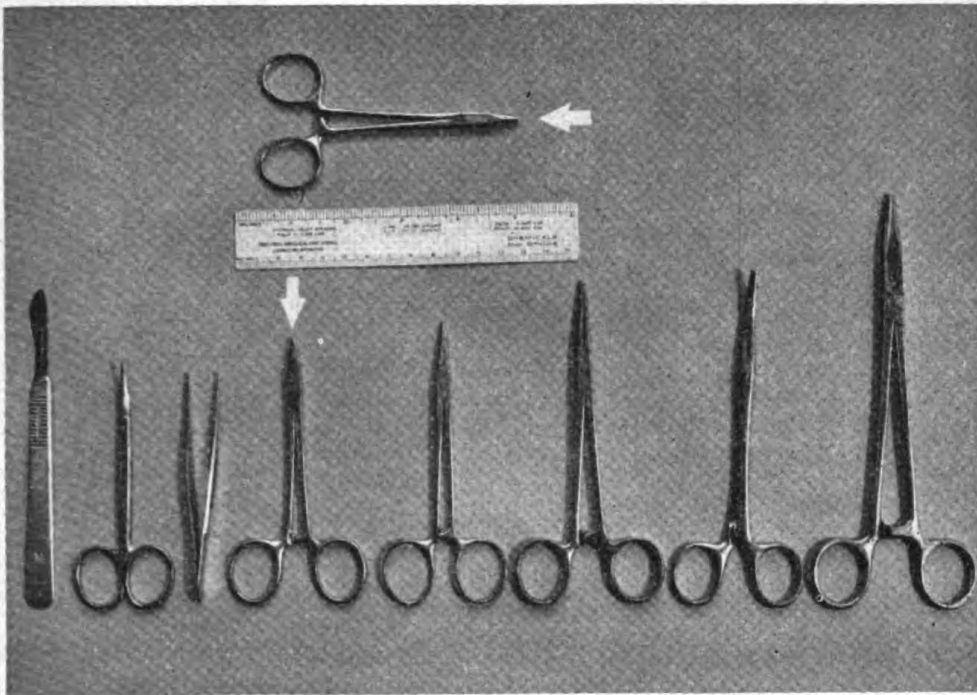
THE AUTHOR'S NEEDLE HOLDER

The needle holder presented in this article is a very simple instrument. It is so simple that, like many inventions, one wonders why

² Wiggam, A. E.: The one best way. Published in the Reader's Digest, December 1937.

it was not developed long ago. Nevertheless, there is no such instrument to be found amid the myriads of surgical instruments now on the market. It is made from a standard mosquito-clamp forging, and has the following features:

1. It is a small instrument (fig. 2), $4\frac{1}{2}$ inches in length. As such, it fits neatly into the operator's hand. The extended index finger steadies the tip of the instrument (fig. 3) so that very accurate control is obtained and sutures can be placed with great precision. It can also be manipulated handily into small spaces, and is useful for suturing in such locations as inside of a nose, a child's mouth, or in the many awkward situations encountered in suturing a flap with a plaster cast in place.

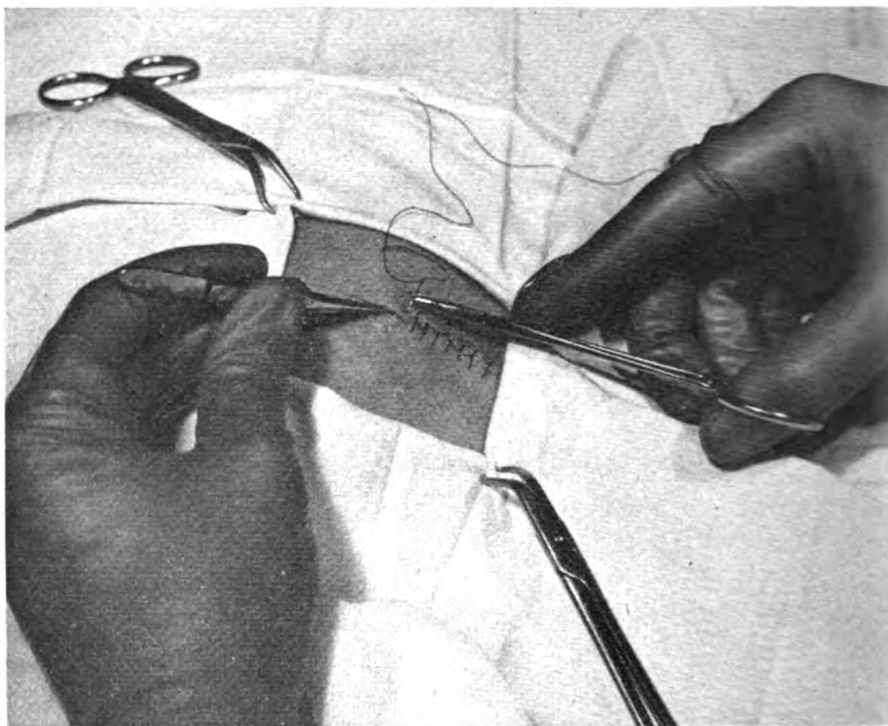


Official United States Navy Photograph

2. THE AUTHOR'S NEEDLE HOLDER IS INDICATED BY THE ARROWS. FOR COMPARISON OF SIZE, IN ADDITION TO THE RULER, THERE ARE SHOWN, LEFT TO RIGHT: A NO. 3 BARD-PARKER HANDLE AND A NO. 10 BLADE; A SMALL IRIS SCISSORS; A SMALL IRIS FORCEPS, RAT-TOOTHED; THE NEEDLE HOLDER; A MOSQUITO CLAMP; A HALSTED STRAIGHT HEMOSTAT; A CURVED KELLY HEMOSTAT; AND A GENERAL OPERATING, $7\frac{1}{2}$ -INCH NEEDLE HOLDER.

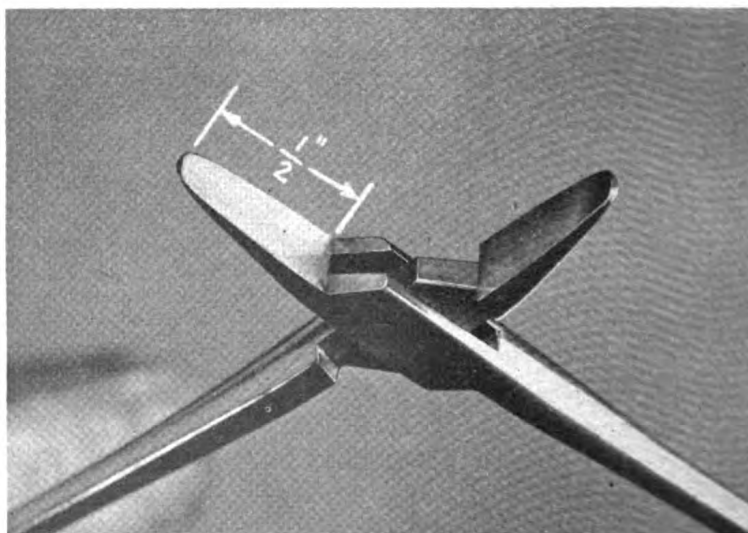
2. Its grip and lock are familiar to the surgeon. The hemostat grip and lock are so fundamentally a part of the surgeon's manual practice that there is at once a familiar "feel" and sense of balance in using this needle holder.

3. The jaws are absolutely flat (fig. 4) with slightly rounded edges. There are no serrations and no deep central groove. This furnishes a secure, noncutting grip even with the finest silk suture. It is an-



Official United States Navy Photograph

3. THE NEEDLE HOLDER IN USE. NOTE THE SIZE IN RELATION TO THE OPERATOR'S HAND, THE SMALL RADIUS OF MOTION, AND THE EASE OF USE OF THE INDEX FINGER TO STEADY THE TIP OF THE INSTRUMENT. THIS ELIMINATES MUCH TREMOR AND INACCURACY IN PLACING SMALL SUTURES.



Official United States Navy Photograph

4. ENLARGED VIEW OF JAWS, SHOWING POLISHED FLAT SURFACE WITHOUT SERRATIONS OR GROOVE, AND ROUNDED EDGES OF JAWS AND OF CORNERS OF BOX HINGE WHICH AVOID CATCHING SUTURE WHILE TYING.

noying and inefficient to have a thread slip repeatedly through the jaws of a needle holder when tying, or to have the thread crushed as it is pulled taut.

It might be argued that a flat jaw, gripping the curved needle would tend to flatten or break the needle. This is true when the needle is gripped back in the main body of the jaws, but the very tip of the jaws are intentionally narrowed for grasping the needle, and when the needle is mounted in the tip of the jaws there is little danger of breaking.

4. The box-hinge corners are slightly rounded to allow the thread to slide down over the hinge without catching, when the knot is being tied. This works very well if the needle holder is closed as soon as the thread is gripped in the jaws. If the jaws are incompletely closed at this point, the thread may catch in the hinge. It is not possible to construct a box hinge which will positively never catch the thread, but by closing the jaws on the thread, when grasping it, and then pulling down the loop over the hinge to tie the knot, almost no difficulty is encountered in this respect. With a little practice, this knack is easily acquired and becomes automatic.

SUMMARY

A small needle holder, the size of a mosquito clamp is introduced. It is compared in several ways with the only other special plastic needle holder which was designed some years ago by Sir Harold Gillies.

The special features of the new needle holder are as follows:

1. Small, handy size, with light weight and "natural" balance.
2. Familiar grip and lock mechanism (the mosquito clamp forging is used to make this instrument).
3. Flat, smooth jaws—for easily gripping the thread when tying and securely holding the small eye needles used in plastic surgery.
4. Smooth box hinge—to prevent catching of the thread in the hinge when tying.

DETERMINATION OF SULFONAMIDES ¹

A MODIFIED FIELD PROCEDURE

JOHN J. ENGELFRIED

Lieutenant Commander H-V(S) U. S. N. R.

Various methods of determining the concentration of the sulfonamides in blood and other body fluids and tissues have been published,

¹ Received for publication February 19, 1943.

which, however, are largely dependent upon the facilities of a modern hospital laboratory.

At present these drugs are often administered on land and at sea by medical officers of the armed forces who do not have laboratory facilities. Therefore, it would be advisable to have a simplified procedure by which the presence of the sulfonamides in the body fluids could easily be determined and a quantity estimation made, without requiring the use of a colorimeter or of reagents that would not be readily available. The procedure presented here is primarily for use under such conditions.

The procedure is briefly summarized as follows: (a) The proteins are removed by precipitation with 95 percent alcohol; (b) the alcoholic filtrate is acidified with hydrochloric acid; (c) a small piece of nitrite paper is added, followed by the addition of another piece of paper containing an azo dye; (d) the resulting color is compared to a standard solution of sulfonamide similarly treated. The use of a colorimeter is not necessary.

PROCEDURE FOR TEST

A. PREPARATION OF MATERIALS.

1. *Nitrite paper.*²—A 10 percent aqueous solution of sodium nitrite is poured over sheets of any available filter paper in a beaker or other glass container. The papers are removed, allowed to dry, and cut into strips approximately 5 mm. in width. The strips are stored in a wide-mouth amber bottle, or, if space is limited, may be kept in a small envelope.

2. *Azo-dye paper.*²—An aqueous solution of 1 percent N-(1-naphthyl)-ethylenediamine dihydrochloride is absorbed on filter paper using same technic as for the preparation of the nitrite paper. After drying, the strips are cut to approximately 1 cm. width.

3. *Preparation of standard.*—If a chemically pure drug is not available, satisfactory clinical results can be obtained with tablets suitable for oral administration. The tablets used by the Navy contain approximately 7.5 gr. (0.5 gm.) of the drug, with the exception of sulfanilamide tablets which contain only 5 gr. (0.333 gm.).

(a) *Stock standard solution.*—One 0.5 gm. tablet is dissolved in approximately 950 cc. of water in a liter volumetric flask (or as accurate a measuring container as obtainable), and diluted with water to 1 liter. NOTE: Starch is present in these tablets, acting as a binder, and will not dissolve.

(b) *Working standard solution.*—Shake the stock solution before using and transfer 10 cc. to 100 cc. volumetric flask (or as

² These solutions need not be accurately made. However, it is necessary that all of the filter paper be covered by the solutions when absorbing them.

accurate a measuring container as obtainable), and dilute with water to 100 cc. (1 cc. of working standard will contain approximately 0.05 mg.) A slight turbidity in the standard due to presence of starch will not interfere with the test.

4. *Preparation of acid.*—Approximately 1 normal HCl in alcohol is used. This can be made by adding 1 cc. of concentrated HCl to 11 cc. of 95 percent alcohol. (C. P. acid preferred but a commercial quality will give satisfactory results.)

B. PREPARATION OF FILTRATE.

1. Measure 27 cc. of 95 percent ethyl alcohol into a 125-cc. flask. Pipette exactly 3 cc. of whole oxalated blood into the alcohol. Stopper flask and shake well. Allow the flask to stand approximately 10 minutes with occasional shaking.

2. Filter through filter paper into a tube or flask. (The funnel should be covered during the process of filtration to prevent loss of alcohol by evaporation.)

C. PERFORMANCE OF TEST.

Using 125-cc. flasks or large tubes:

Standard

- (1) 1 cc. of working standard.
- (2) 9 cc. of alcohol.

Unknown

- (1a) 10 cc. of alcoholic filtrate.

In the remaining part of the procedure the same reagents and quantities are added to both standard and unknown.

(3) Add 1 cc. of 1 normal HCl (in alcohol). Shake.

(4) Add one small piece of nitrite paper to each flask. (Size of paper approximately 3 x 5 mm.) Shake intermittently for 3 minutes.

(5) Add one piece of dye paper. (Size approximately 10 x 25 mm.) Shake intermittently for 10 minutes.

(6) Read in colorimeter if available, otherwise, use the following procedure:

D. COMPARISON OF COLOR WITHOUT USE OF A COLORIMETER.

Select two test tubes of the *same diameter* and the same type. Pipette exactly 5 cc. of the standard in tube marked "S" and 5 cc. of the unknown into the other tube.

If unknown is darker than standard.—Dilute unknown with alcohol, carefully observing the amount of alcohol required to bring the color of both tubes to an equal intensity.

If unknown is lighter than standard.—Dilute standard with alcohol until the intensity of both tubes is equal.

E. CALCULATION.

1. If the standard and unknown are equal without any dilution, the unknown will contain 5 mg. of sulfonamide per 100 cc. of blood.

2. If the unknown originally was darker than the standard, the number of cubic centimeters of alcohol required for the dilution of +5, equals the milligram of the sulfonamide per 100 cc. of blood.

Example: If the 5 cc. of the unknown required 3.5 cc. of alcohol to match the standard, then $3.5+5=8.5$ mg. of sulfonamide per 100 cc. of blood.

3. If the unknown is lighter than the standard, then use the following equation:

$$\text{mg. per 100 cc. blood} = \frac{5}{\left(\frac{\text{cc. of alcohol used for dilution} + 5}{5} \right)}$$

Example: If the 5 cc. of standard required 3.5 cc. of alcohol to match the unknown, then:

$$\frac{5}{\left(\frac{3.5+5}{5} \right)} = \frac{5}{\left(\frac{8.5}{5} \right)} = \frac{5}{1.7} = 2.95 \text{ mg./100 cc. of blood}$$

or

$$\frac{25}{\text{cc. of alcohol} + 5} = \frac{25}{3.5+5} = \frac{25}{8.5} = 2.95$$

F. POSSIBLE VARIATIONS THAT MAY BE OF VALUE.

1. It is not necessary to use a separate standard solution for each sulfonamide. Sulfanilamide or sulfathiazole can be used for the standard and the results obtained are multiplied by a conversion factor. If sulfanilamide is used for the standard, the conversion factors are as follows: For sulfapyridine and sulfadiazine 1.45; for sulfathiazole 1.48. If sulfathiazole is used for the standard, the conversion factors are as follows: For sulfapyridine and sulfadiazine 0.98; for sulfanilamide 0.68.

2. If HCl is not available, a 10 normal solution of H_2SO_4 may be used for acidification of the filtrate and standard (the color is not as intense as that produced when HCl is used). Sulfuric acid should only be used when HCl is not available.

3. A 0.1 percent aqueous solution of N-(1-naphthyl)-ethylenediamine dihydrochloride can be used with the nitrite paper.

4. It is preferable to use distilled water and C. P. acid; however, it is not necessary. If the use of nondistilled water (in preparation of the standard), commercial acid or dirty alcohol, is necessary, then a blank determination should be made to insure the absence of any interfering substance.

5. The procedure also will give satisfactory results for sulfonamide estimations in urine and other fluids.

RESULTS

Filter paper impregnated with sodium nitrite and a 1 percent N-(1-naphthyl)-ethylenediamine dihydrochloride were prepared according to the previously described technic. Both types of prepared paper gave satisfactory results after 75-days' storage in amber bottles at room temperature, and after 30 days in amber bottle at 37° C. (The bottles were uncovered for 5 minutes each day.) An increase in humidity did not appear to impair the results. Favorable results also were obtained with the prepared papers that were placed in covered Petri dishes, exposed to sunlight for a period of 30 days.

Determination on 81 consecutive routine blood specimens were made using the standard Navy method (trichloroacetic acid) by two different individuals and compared to the results obtained using the previously described procedure. Table 1 illustrates the results obtained.

TABLE 1.—*Results obtained with routine blood specimens*
[Comparing the "Standard Navy Method" to the "Modified Alcohol Procedure"]

Specimen No.	Standard navy method		Modified alcohol method	Specimen No.	Standard navy method		Modified alcohol method
	First ¹ determination	Second ¹ determination			First ¹ determination	Second ¹ determination	
	Milligrams, percent	Milligrams, percent	Milligrams, percent		Milligrams, percent	Milligrams, percent	Milligrams, percent
1.....	5.1	4.7	5.0	42.....		5.3	5.7
2.....	6.4		6.5	43.....		8.3	8.9
3.....	Trace	Trace	Trace	44.....		6.0	6.8
4.....	Trace	Trace	Trace	45.....		2.7	2.4
5.....	Trace	Trace	9	46.....		12.5	12.9
6.....	2.5	2.7	2.5	47.....		4.4	3.8
7.....	3.5	3.6	3.5	48.....		4.7	5.7
8.....	5.2	5.2	5.3	49.....		5.0	5.8
9.....	2.5	3.5	5.0	50.....		2.9	3.1
10.....	5.3		5.7	51.....		5.8	6.0
11.....	5.8	5.8	8.0	52.....		3.1	3.6
12.....	Trace	Trace	Trace	53 ²	6.1		6.2
13.....	2.3	2.6	2.5	54.....	5.0	5.5	5.0
14.....	None	None	None	55.....	7.5	8.3	7.5
15.....	3.6	4.5	6.5	56.....	9.7	9.8	10.0
16.....	5.0	4.7	4.8	57.....	5.0	6.0	6.2
17.....	Trace	2.6	3.2	58.....	5.8	5.0	4.5
18.....	1.7	2.8	3.0	59.....	10.2	10.2	9.5
19.....	Trace	3.1	3.5	60.....	5.3	6.0	5.5
20.....	1.3	2.4	3.2	61.....	5.5	5.2	5.0
21.....	3.1	2.9	2.8	62.....		7.5	8.5
22.....	5.0	5.1	5.0	63.....		10.7	9.5
23.....	5.3	5.5	5.8	64.....		6.0	6.5
24.....	None	None	None	65.....		5.5	4.6
25.....	4.3	4.5	5.0	66.....		4.8	5.4
26.....	3.4	3.4	3.7	67.....		9.1	8.5
27.....	Trace	Trace	Trace	68.....		12.5	10.8
28.....	3.0	3.8	4.3	69.....		11.1	11.0
29.....	Trace	Trace	Trace	70.....		6.8	7.6
30.....	4.3	4.5	4.7	71.....		8.3	8.0
31.....	3.9	4.5	5.5	72.....		14.3	14.0
32.....	3.9	3.4	3.8	73.....		12.0	11.8
33.....	2.4	3.2	3.1	74.....		6.2	6.6
34.....		2.5	2.8	75.....		8.7	9.0
35.....	3.1		3.3	76.....		6.8	7.0
36.....	4.6	4.4	4.5	77.....		7.5	7.9
37.....		2.1	3.2	78.....		8.5	8.9
38.....		2.5	4.0	79.....		11.6	11.3
39.....		3.5	3.6	80.....		10.3	10.8
40.....		5.2	4.8	81.....		4.1	3.7
41.....		4.3	4.5	82.....	3.9	3.8	3.8

¹ These determinations were made by different workers on separate filtrate.

² Specimens Nos. 1-52 were sulfathiazole determinations; Nos. 53-81, sulfadiazine, and 82 was a sulfanilamide.

COMMENTS

1. The results obtained indicate that the nitrite paper appears to be of value when equipment is not available for keeping a nitrite solution in refrigeration or for the preparation of a fresh solution daily.

2. The nitrite paper remained stable, at room temperature, when stored in an amber bottle for 70 days. At present there is no proof that the nitrite or dye paper will remain stable for a longer period of time or under severe climatic conditions.

3. Satisfactory results can be obtained without using a colorimeter for comparison of color.

4. This procedure is not recommended for a well-equipped hospital or research laboratory; but, as previously stated, is to be used in a temporary laboratory.

Addendum.—The original nitrite and dye papers were retested on July 21, 1943. (These papers had been stored in amber bottles at room temperature for 229 days.) No deterioration of activity of the nitrite or dye paper could be detected.

SICKBAY SUGGESTIONS FOR NAVY SCHOOLS¹

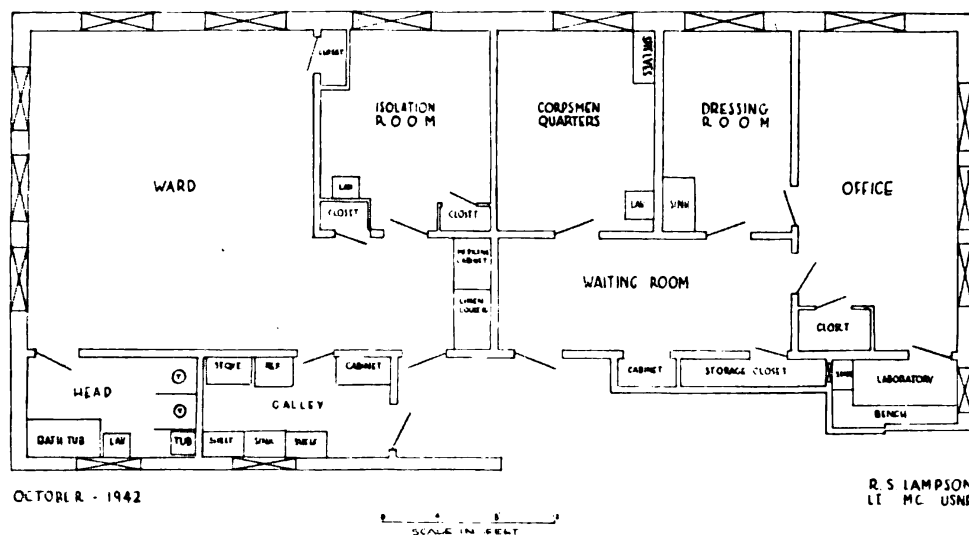
R. STARR LAMPSON
Lieutenant (MC) U. S. N. R.
and
JOSEPH H. BROUILLETTE, JR.
Pharmacist U. S. N.

The Navy program for the education of young men and women to become officers and technical experts has gained such momentum that many training centers have been and are being established at colleges and schools, using existing available buildings and facilities. Along with this expansion comes the need for medical care of the personnel under training, for which there is often no provision in the physical structure of the buildings taken over for training purposes. This situation existed at the Maine Maritime Academy where a school for training United States Naval Reserve Midshipmen to serve in the Merchant Marine Service was recently established in the buildings of the old Eastern Maine Normal School. Plans were drawn and spaces remodeled in an existing building to meet the requirements of the Medical Department, and to provide accommodations for the sick. The new sick quarters have proved so ideal for our needs that we are presenting the design for consideration by anyone who may be confronted with a similar problem.

¹ Received for publication April 13, 1943.

Two adjacent classrooms on the ground floor in a wing of the administration building were allotted to the Medical Department and the alterations were carried out by a local contractor from Academy funds according to the accompanying plans. The sick quarters consist of a ward, an isolation room, a toilet room, a galley, a doctor's office, a dressing room, a laboratory, a waiting room, corpsmen's quarters, and sundry storage closets, as shown in the plans. The normal capacity is 7 patients, 5 in the ward, and 2 in the isolation room. This number of patients can be increased to 16 by using double-decker beds. Daylight and ventilation are plentifully supplied by numerous large windows shaded with venetian blinds. Artificial light is furnished by indirect lighting fixtures and there are many electric floor outlets for the use of portable equipment. Heat is provided by steam ra-

SICK BAY
MAINE MARITIME ACADEMY



diators connected to a central heating system. The partitions are temporary, consisting of fabricated wall material secured to wooden studding (new partitions are shaded on plan). This type of construction is sturdy, easy to erect, and requires no essential war materials. The temporary partitions can be readily removed should the restoration of the acquired spaces to their former use be desired. A cheerful atmosphere has been achieved with a washable waxbase paint applied in two shades of light green.

In conceiving a plan for new sick quarters, existing medical facilities in the community should be investigated and their availability determined. No provision for major surgical procedures or for x-ray equipment was made in the above scheme because a well-equipped operating room and adequate x-ray facilities are accessible at the local com-

munity hospital. The plan which has been presented is flexible and will allow for expansion and change. The corpsmen's quarters can be readily adapted for an operating room and part of the storage closet could be converted into a darkroom for developing x-rays.

THE CONVERSION OF LIQUID TO GASEOUS OXYGEN FOR THERAPY¹

WILLARD BARTLETT, JR.
Lieutenant Commander (MC) U. S. N. R.

Oxygen is the substance most immediately vital to living tissues. Oxygen deficiency is a serious situation common to a variety of clinical conditions in which impaired intake, transportation, or utilization of oxygen may initiate or increase cell damage that becomes irreversible if sufficiently severe or prolonged. A rapidly increasing recognition of the impairment of oxygen transport by the circulation in cases of intestinal obstruction, burns, shock, and a host of metabolic disorders adds many new indications for the administration of oxygen.

We have been severely limited by the cost of oxygen therapy, however, since the average daily charge for gaseous oxygen in therapeutic quantities is about equivalent to the daily expense for special nursing in many communities, and the patients who most obviously need continuous oxygen therapy generally require such special nursing. When these costs are added to the fixed charges, a total of daily hospital expenses amounting to \$50 or more, is easily attained and the need for services and supplies at such a rate may be existent for days. This becomes an economically impossible situation. The physician avoids or delays the use of oxygen therapy, except in grossly cyanotic patients. When oxygen becomes available for therapeutic purposes at a much smaller cost, it will be used with as little thought of expense as are dextrose solutions for intravenous administration. Only when such a reduction in price occurs can the use of oxygen as a prophylactic measure be realized.

Oxygen for medical use is first manufactured as liquid oxygen, vaporized, then compressed into steel cylinders for transportation and handling. The fixed expenses incidental to this roundabout process of vaporization and compression place upon the user, in addition to the small cost of the original liquid oxygen, the cost of the subsequent processes and services, this necessarily high. Transportation charges on the empty cylinder are several times the cost of recharging the cylinder with gas.

¹ Received for publication June 30, 1942.

Liquid oxygen can be readily transported and stored in containers weighing much less than the contained liquid. A standard 25 liter Dewar flask weighs 42 pounds empty and will store 62 pounds of liquid oxygen with a loss of about 4 pounds in 24 hours due to evaporation. (In larger containers the rate of evaporation is much lower and evaporation losses of as little as $\frac{1}{10}$ of 1 percent have been noted.) Liquid oxygen may be purchased, in a container furnished by the dispenser, at a price of 6 cents per pound at a distance of 300 miles from the source of supply. In larger quantities the price ranges downward to 3 cents per pound. In considering the implications of these figures one must recall that liquid oxygen, the critical temperature of which is -300° F., expands at atmospheric pressure to 800 times its volume. Twenty-five liters of liquid oxygen, upon vaporization, yield 20,000 liters of gaseous oxygen, sufficient to maintain a constant intake of 4 liters per minute for over 3 days. If the final agency (such as a hospital) handling the liquid oxygen for therapeutic purposes, paid as much as 5 cents per pound, the total cost of 25 liters of liquid (which weigh 62 pounds) would be just over \$3, or less than \$1 per day at the rate of 4 liters per minute. Oxygen requires no more care in its handling in the liquid state than it does when compressed as a gas.

The design and manufacture of apparatus for the vaporization of oxygen at a measured and controllable rate have offered baffling problems. Such apparatus as has been developed has functioned through various applications of the principle of increasing the rate of vaporization by raising the temperature of the liquid. In earlier forms the introduction to a varying depth or in varying numbers of such conductors as copper rods was utilized, but they presented the difficulties of constant alteration in the effectiveness of conduction as frosting occurred and as the level of the liquid fell. In recent years an apparatus has been perfected in which the temperature of the conductor is varied at will by the amount of electrical current passed through a heating element contained in a closed tube immersed in the liquid. The gaseous oxygen passes out through the neck of a Dewar flask through a warming coil to a kinetic flowmeter, from the outlet of which it may be dispensed by whatever means desired. A voltmeter, connected across the terminals of the heating element, is calibrated in terms of liters per minute, and the desired rate of administration is obtained by merely setting a rheostat. The entire unit, which rests on the Dewar flask, is not as large as the average storage battery case.²

² Two of these units for the controlled vaporization of liquid oxygen have been in use for a considerable period in a hospital attended by the writer. House officers and nursing attendants alike have been enthusiastic over the simplicity and dependability of the device. The liquid oxygen was supplied from a local industrial source.

ULCEROMEMBRANOUS GINGIVITIS¹

A PLAN FOR SIMPLIFIED TREATMENT

JEROME B. CASEY

Lieutenant Commander (DC) U. S. N.

In the common experience of the dentist connected with the armed forces, the proportionate amount of Vincent's infection to be treated has increased, even in activities engaging personnel considerably advanced over the recruit stage. For example, while in peacetime years the worst cases—excepting those in veterans engaged in a battle with a terminal illness—were seen in the young recruit, leaving the in-between personnel relatively free, in these wartimes the spread of severe cases is more uniform. The young ones get the new cases. The older ones get not only the new cases but recurrences of the old. In many of these cases previously treated, and showing recurrence, the patient on examination and questioning has shown very little realization of his part in curative and preventive treatment of trench mouth. Apparently oral instructions have not had the necessary effect. It was thought at this activity, where the personnel is relatively advanced over the "boot" stage, that the effect of written instructions, quoted below, could be judged with an approximate degree of accuracy:

TRENCH MOUTH (VINCENT'S INFECTION)

INSTRUCTIONS FOR PATIENT

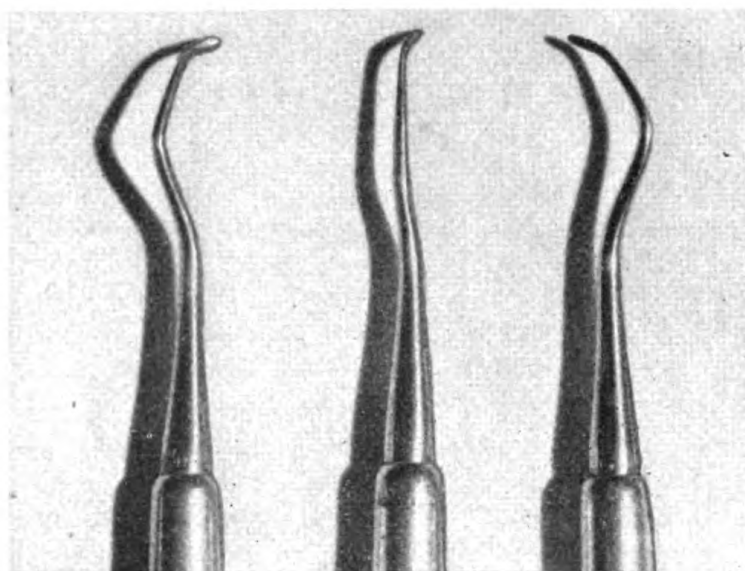
1. The big idea in treating trench mouth is to get the mouth clean and to keep it that way. Hence persistence in oral hygiene is necessary.
2. Start using a mouth wash (prescribed by dental officer) at least twice a day and continue until symptoms have disappeared.
3. Do not brush teeth or gums for several days (until ulcerated appearance has disappeared), then use new toothbrushes (throw away the brushes you have been using) with any accepted dentifrice, powder or paste, brushing more vigorously as symptoms subside.
4. Discontinue the use of alcohol and tobacco until all symptoms of trench mouth have disappeared.
5. Step up your intake of citrus fruit, tomato juice, and fresh leafy vegetables.
6. The above will remove the odor, loose debris, etc., but treatment at the dental office is necessary in order to remove plaques, membranes, overhanging fillings, crowns, etc. Do not miss your appointments, which are short and are of value in cleaning up the mouth more quickly.
7. Be careful about passing on the infection to others, via swapping "butts", unwashed utensils, etc.

¹ Received for publication March 2, 1943.

The advice about waiting until the ulcers have disappeared is, of course, a phrase intended for the casual glance of the patient. The reference to mouth odor was thought advisable in stimulating the patient to greater effort in removing the causes of such odor.

Since instituting the above, the patients returning for subsequent treatments following reception of written instructions have uniformly shown an improved response to treatment which could not be explained by the use of the customary drugs used in the local care.

One other means of taking up the slack in Vincent's infection has been noted: We have accumulated a number of scaling instruments, "one for every stroke". This to my mind is a mistake in treating gingivitis conditions. The rate of curve at the neck of the tooth does not vary enough to justify the diversity of instruments. If the end of the scaler for posterior teeth is rounded (so as not to nick gum and peridental fibers, or tooth structure), if the shank is curved so



1. BUNTING SCALERS, SIZES 1, 5, AND 6.

as to allow working $\frac{1}{4}$ inch around a 90° angle, if the width of the cutting blade is not wider than the distance the free gingival margin can be comfortably separated from the gum, and if the end of the blade does not lie so far beyond the prolongation of the line of the handle as to interfere with feeling one's way and controlling easily the path of the instrument, a great deal of scaling can be done with very few instruments. The Bunting scalers numbered 1, 5, and 6 have shown themselves very efficient (fig. 1). Through their use a fine sense of touch may be developed and an excellent piece of work done by the average technician.

The big disadvantage in dentistry as compared with general surgery is that the field is small, and not easily seen. Hence it is well to choose instruments that allow the operator, even if relatively inexperienced, to judge easily the path of the instrument's working surface, thus saving the gums and peridental membrane considerable trauma.

SUMMARY

A line of attack on trench mouth is presented via:

1. Use of printed instructions which appeal to the patient's sense of cleanliness—the Navy tradition.
2. Improving the local care at the dental office by decreasing the number of scaling instruments through a judicious choice, keeping in mind the average technician.

A SIMPLE PROCEDURE FOR THE CONTROL OF FUNGUS INFECTION OF THE FEET¹

RODNEY F. ATSATT

Commander (MC) U. S. N. R., retired

This station was placed in commission on July 7, 1942, with a strength of approximately 100 enlisted personnel. At that time the dispensary was seeing each day, 3 to 5 new or old cases of epidermophyton infection.

The following regime was instituted immediately. Foot baths were constructed, using No. 26 galvanized iron. They were 20 inches square and 3 inches deep. The top edges were rolled over a 1/2-inch wooden frame and then reframed with 1/2-inch wooden strips to obviate corners and edges. A freshly prepared formaldehyde solution, 2 ounces to the gallon, is placed in the foot baths each morning by the head detail.

The procedure in use for these foot baths is for the man to dry himself down to his feet and then stand 15 seconds in the foot bath. By the time he has dried his feet thoroughly, especially between his toes, he will have had at least a minute's exposure to the solution.

Another important provision is that there shall be no wooden gratings on the deck of the shower room. Wooden gratings are highly insanitary, providing good places for the fungus to grow. If the tile or painted decks are bare, they soon become wet with the

¹ Received for publication December 9, 1942.

formaldehyde solution and while they look unclean, they really are germicidal.

For the local lesions, a two-thirds strength Wilkinson's ointment was used. The preparation of this compound ointment of sulfur is as follows: 15 percent of sublimed sulfur and 10 percent of precipitated calcium carbonate are incorporated in a mixture containing 15 percent oil of cade, or juniper tar, 30 percent of soft soap, and 30 percent of lard. This basic ointment, sometimes also known as Hebra's itch ointment, is diluted one-third with zinc oxide ointment.

Only one precaution should be exercised in the use of this ointment. It should be used sparingly. Just enough should be used to color the skin—it should not be used lavishly or a dry scaly skin will result.

While epidermophytosis is commonly considered to be a foot infection, there are many other situations in which it flourishes. The common jock itch, many cases of pruritus ani, the old-fashioned salt rheum itch, occurring on hands, forearms, and ears—all these entities are often fungus disease and as such, react favorably to Wilkinson's ointment.

Since the institution of the above-described regime the case attendance of fungus infection of the feet has dropped to approximately one per week, and these cases are usually in new arrivals.



MASSAGE FOR ADIPOSE TISSUE

There seems to be a general misconception concerning the effect of massage on adipose tissue. Commonly it is believed that heavy massage can be employed to remove deposits of fat in various regions of the body. Clinical observation has not supported this conception.

When Carl Rosenthal investigated this problem experimentally (*Die Massage und ihre wissenschaftliche Begründung*, Berlin, 1910) he was able to demonstrate that vigorous massage of the abdominal walls of animals produced no destructive effect whatever on the adipose tissue. Following very heavy massage, he made microscopic sections of the adipose tissue which showed no changes in the fat although the pressure had been sufficiently severe to produce multiple hemorrhages. The studies of Rosenthal seem to indicate the futility of attempting, by means of massage, to reduce local deposits of fat.

It can be concluded, therefore, that in normal persons heavy massage to the thighs or abdomen would probably do little damage to the lymphatics or liver but that the procedure would be futile as far as its effectiveness in removing deposits of adipose tissue is concerned.—Queries and notes. J. A. M. A. 122: 208, May 15, 1943.

EDITORIALS

DEBRIDEMENT VERSUS CONSERVANCY

Recent reports from battle areas emphasize the importance of conservancy in wound management.^{1 2 3} The impetus to radical debridement inherited from World War I is waning before the accumulated evidence of good end results from minimal surgical interference. The savage sacrifice of tissue, with meticulous pruning of crinkled flesh, appears to be sheer waste of surgical energies, the patient frequently not the gainer.

The proposal of Trueta⁴ to debride until red contractile tissue is reached has its antithesis in Barnes'⁵ simple application of sterile surgical gauze with incorporation in plaster cast.

The decline in incidence of serious wound infection is attributable to whatever method utilized. Uniformity of opinion exists regarding the importance of adequate immobilization.

Several other factors however must be considered. The role of sulfonamides has unquestionably a preeminent status. Irrespective of increasing evidence of failure narrowing the universal applicability of the drug, most wounds appear the better for having had an early and generous sprinkling of some form of sulfonamide.

Frequent change of dressings with wound manipulation have a deleterious effect and call for a more laissez-faire attitude. Crile² in the *BULLETIN* recently directed attention to the exacerbation of symptoms with each early interruption of dressings for wound inspection, and commented upon the advantages of watchful waiting.

That other factors exist however is apparent. What part locale or terrain plays upon the incidence of infection has not been determined satisfactorily. For the most part this war has been fought on virgin,

¹ Ferguson, L. K.; Brown, R. B.; Nicholson, J. T.; and Stedman, H. E.: Observations on the treatment of battle wounds aboard a hospital ship. *U. S. Nav. Med. Bull.* 41: 299-305, March 1943.

² Crile, G., Jr.: Experiences of the surgical service of the U. S. Naval Hospital, Auckland, New Zealand, with casualties from the initial Solomon Islands engagement. *U. S. Nav. Med. Bull.* 41: 306-324, March 1943.

³ Littlejohn, C. W. B.: Report on the early treatment and results of penetrating wounds of the chest. *Australian & New Zealand J. Surg.* 11: 147-152, January 1942.

⁴ Trueta, J.: *The Principles and Practice of War Surgery*. C. V. Mosby Co., St. Louis, 1942.

⁵ Barnes, J. M.: Treatment of Burns. *Brit. M. J.* 1: 408, April 3, 1943.

uncultivated fields free of virulent organisms, or at least of forms which include man as an acceptable host.

It is intriguing to learn that Teutonic definitive procedure in wound management⁶ also consists in: (1) A minimum of debridement; (2) sulfanilamide powder dusted into the wound; (3) no closure; and (4) immobilization by plaster cast with window.

HOT OR COLD

Sometimes extreme measures are taken at great trouble to supply external heat or cold to the seriously ill patient. Proper evaluation of what is environmentally best for such a patient has been given little consideration until recently. The attendant applies heat for the chill and ice to the fevered brow without thought to the body's wisdom in its physiologic response to adverse conditions.

Too often treatment has been directed to fit the personal impressions of the observer, without intelligent understanding of the basic physiology present. The thought expressed in a recent editorial¹ on this subject is well taken.

Many of us have had the unfortunate experience of finding "well trained" people working hard to warm up a patient with cold, clammy skin when the rectal temperature was found to be 105° to 106° F., much to the consternation of all concerned except the patient, who by this time has ceased trying to remove the covers.

The factor of environmental temperature, particularly in shock, doubtless has been exaggerated. First-aid instructions have helped not a little to further this paradox. It is not certain that the patient in shock, unless his actual body temperature is below normal, requires an environmental temperature much above that which is congenial to the healthy bystander. Conversely, application of the generally used heat cradle to the burned patient may be definitely detrimental. Recent investigations² have indicated that the mortality in extensive burns has been adversely influenced by such applications.

It is heartening to know that our fighting men need not suffer unduly from want of these appliances; on the contrary perhaps will be benefited by their lack.

⁶ Gautier R: Address, Academy of Medicine, Washington, D. C., May 25, 1943.

¹ Editorial: Cooling shock. J. A. M. A. 121: 432-433, February 6, 1943.

² Elman, R.; Cox, W. M., Jr.; Lischer, C. E.; and Mueller, A. J.: Mortality in severe experimental burns as affected by environmental temperature. Proc. Soc. Exper. Biol. & Med. 51: 350-351, December 1942.

THE PROBLEM OF INTERVERTEBRAL DISC

In recent years ruptured or herniated intervertebral disc has become one of the most common diagnoses for low back pain, especially if sciatica is present. Operation for this lesion incidentally is becoming one of the most common surgical procedures.

Causative agents responsible for such an injury are often apparently insignificant. Love lists such items as the jolting of an extensive automobile ride, horseback riding, lifting of heavy objects, falling on the ice, and the like.

In the light of these factors, it is not surprising to find increased incidences of herniated disc among service personnel. Werden in the March issue and Hare and Langs in the present *BULLETIN*, page 1263, corroborate this finding.

It is conceivable how such activities as operating a tank, paratroop and aircraft landings, jeep travel, and the like would expose one to sufficient trauma to produce a lesion of the character of a protruding disc. The literature appears to emphasize the history of a single simple exertion or strain as a causative factor in most instances.

It is likewise intelligible how a sudden force applied at a fulcrum point could snap the posterior longitudinal ligament and permit the protrusion of a disc. More important, however, is the understanding of how slight anomalies as scoliosis, lordosis, various degrees of curvature, and apposition of the units of the spine affect the production of herniated discs.

Abnormal stresses and violent separations of the ligament fibers are easily possible under these conditions, a point worthy of more emphasis and opportunely discussed by Hare and Langs.

The diagnosis of herniated disc presents some problems of considerable magnitude. Many neurosurgeons are unswerving in their opinion that the pathology is discernible on clinical findings only. They are vehement in their denunciation of the introduction of roentgen aids into the spinal canal for diagnostic purposes. The serious consequences and the results obtainable are deemed out of proportion and hence unwarranted.

Opaque material even after recovery by subsequent withdrawal has occasioned medicolegal liabilities of notable significance. It is refreshing to know what good results are obtainable by oxygen injection according to the Hare and Langs technic. Gaseous materials are definitely innocuous as compared with the introduction of opaque material. Undoubtedly, these would be the personal choice of most diagnosticians should such a course become necessary.

Dandy on the other hand thinks that the overwhelming percentage of intervertebral disc lesions can be diagnosed and localized by his-

tory and examination alone, and states that all accessory diagnostic tests, even lumbar punctures, can and should be avoided. He is so firmly convinced of this contention that he believes that with a questionable diagnosis an exploratory of the region is preferable to spinal injection of air or iodized oil.

Space devoted to this subject in current literature, and recent advances in the surgical approach, have contributed to the popularization of the operation. Reduction in the quantity of bone excised, the hemilaminectomy utilized by Werden, and now the operation perfected by Love in which no bone whatever is sacrificed, only encourage the surgeon to attempt his series of cases. There are those however who consider conservatism in therapy as the procedure of choice, that operation should be elected only after a fair trial of the many mechanical means and physiotherapeutic devices at the surgeon's disposal. Some claim operation should never be performed prior to several weeks at least of such therapy.

It is difficult to perceive how such a lesion can have assumed the prevalence it has, and in such short period of time. Assuredly, low back pain occurred prior to Dandy's report in 1929 and without the permanent sequelae prognosticated in the light of present day knowledge. Nature must have coped with the problem in other than surgical ways. Certainly the incidence of vertebral disc pathology in the past must have been proportionate to the present circumstances of war. The "railroad spine" has long been an observation of industrial surgeons, relieved not infrequently without surgical intervention. Failure, however, to appraise this situation is considered to have fathered the adjustment cults of today and assuredly will perpetuate them by lack of operative success.

Someone has said that when the operation is absolutely essential it is a gift of God; when the operation is chosen in lieu of simpler methods which will give results, it becomes meddlesome surgery.

RESPIRATION BY SEESAW

The complacency with which a generation has accepted the Schäfer method of resuscitation seems hardly justified. The loss of muscular tone and the soggy, puttylike character of the abdomen and thorax of the semidrowned, make the Schäfer prone-pressure method illogical. The elastic recoil of the chest which one experiences when exercising upon normal subjects and upon which the expansion of the thorax and air intake depend, is lacking in these individuals.

Search for a more applicable and adaptable method has revived interest in the Eve rocking, seesaw technic. In 1932 this method was

described in the *Lancet*.¹ The author, considering the breathing thorax as a cylinder and piston mechanism, exploited the piston action of the diaphragm. In older men the cylinder wall of the chest is often rigid and is scarcely used in respiration at rest. Attempts to compress this rigid thoracic cylinder leaves the diaphragm flapping passively.

By laying the patient, however, on a stretcher which is pivoted at the middle on a trestle, and rhythmically rocking it in a seesaw fashion, the weight of the abdominal viscera pushes the flaccid diaphragm alternately up and down.

Gibbens² revived this principle recently, placing the patient face down on a stretcher with wrists and ankles secured. Rocking through an angle of 60 to 90 degrees on the fulcrum of a trestle or of a suspended rope loop, ventilation of the embarrassed lungs was accomplished adequately. Air could be felt and heard passing in and out freely.

The physical effort required to keep the seesaw in rhythmic motion is minimal. Manipulation by secondary operators to improve ventilation and circulation is eliminated. Gravity alone appears sufficient to aid and maintain these functions satisfactorily; ventilation by shifting the flaccid diaphragm up and down; circulation by encouraging venous return.

The simplicity of the method is appealing. A plank, a dehinged door, a stretcher or any improvised rigid object thrown over a supporting pivot constitute the essentials. Recently Eve³ described the rocking of the victim over the interlocked forearms of two men standing opposite with legs athwart. This can be carried out satisfactorily in a ship's lifeboat.

¹ Eve, F. C.: Actuation of inert diaphragm by gravity method. *Lancet*. 2: 995-997, November 5, 1932.

² Gibbens, G. H.: Artificial respiration at sea. *Brit. M. J.* 2: 751, December 26, 1942.

³ Eve, F. C.: Complacency in resuscitation of the drowned. *Brit. M. J.* 1: 535-537, May 1, 1943.

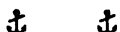


THE PRICE OF PAIN RELIEF

Severe pain in many areas of the body can be relieved, at a price. The pain of trigeminal neuralgia at the price of anesthesia of the face and the remote chance of a persistent paresthesia in the anesthetic zone. The pain of cancer can be relieved—at a price, the price of an operative procedure, loss of sensation, possible motor weakness and sphincteric disturbance. The question becomes, therefore, one of expediency. Is the pain sufficiently severe to advise the patient that the price he may have to pay for relief is not too high?—Grant, F. C.: Surgical methods for relief of pain. *Bull. New York Acad. Med.* 19: 373-385, June 1943.

"LOST PLASMA" IN HEMORRHAGIC SHOCK

There is a theory, known as the "lost plasma" theory, that death results in hemorrhagic shock from reduction in the blood volume by passage of plasma through the capillaries into the tissues. The evidence cannot be said to be absolutely conclusive. An experimental study of the problem has been made on dogs by Fine and Seligman, using a radiobromoprotein, the preparation of which they describe in detail, for the identification of plasma proteins. By injecting this radioprotein into the circulation and tracing its subsequent course, they could follow the movement of plasma proteins from the blood into the tissues in the normal dog as well as in dogs in hemorrhagic shock. The radioactivity of the circulating plasma and of the tissues was the same in the shock dogs as in normal controls. The evidence does not indicate that death from hemorrhagic shock in dogs is caused by a progressive decline in the blood volume due to the passage of plasma into the tissues. The conclusion drawn by Fine and Seligman from their experiments that in hemorrhagic shock of dogs, plasma loss by passage into the tissues is not a crucial factor seems warranted.—Editorial: "Lost plasma" in hemorrhagic shock. J. A. M. A. 121: 1354, Apr. 24, 1943.



NYLON SUTURES

Stronger and less irritating to the body's tissues, nylon has proved a superior replacement for silk in sutures. It will not dry out and rot like the natural fiber, and, therefore, quantities are being made for storage at United Nations' medical depots throughout the world.

Surgeons use as small a suture as is consistent with the strength required, for the smaller material the less the chance of irritation. Nylon has greater tensile strength than silk and can be produced in controlled, uniform diameters.

Nylon monofilaments are solid strands, in contrast to silk sutures which are made by twisting together a number of threads. Skin can grow into the interstices of the braid causing irritation and other complications when the sutures are removed. Smooth, solid nylon precludes this possibility. It is particularly good for heavy wounds, where a "stay suture" is required. The nylon sutures are noncapillary. Germs from infected tissues are not absorbed and cannot travel through the suture as they sometimes do in braided material.

The synthetic is so inert and nonirritating that it can be used internally as well as externally. It does not fray or splinter. There is no chance of small slivers wearing off the suture and working through the body.—Nylon sutures. Hospitals 17: 95, May 1943.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,

UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

SYNOPSIS OF TROPICAL MEDICINE, by *Sir Philip Manson-Bahr, C. M. G., D. S. O., M. D., F. R. C. P., Senior Physician to the Hospital for Tropical Diseases, Royal Albert Dock and Tilbury Hospitals; Consulting Physician in Tropical Diseases to the Dreadnought Seamen's Hospital, London.* 224 pages; illustrated with 5 plates. The Williams & Wilkins Co., Baltimore, Md., publishers, 1943. Price \$2.50.

It is remarkable that so small a book could deal so satisfactorily with so large a subject. It is referred to as a "Synopsis," and it carries out the dictionary definition of condensed statements with headings and subheadings. The type is quite small, but the numerous headings and abundant use of boldface and italic types make its contents quite accessible to the average vision.

The subject matter covers 204 pages and the unusually complete index (for so small a book) 20 pages. There is little margin left on the page, and I would suggest that it be interleaved, thus providing space for notes for medical officers taking the intensive courses, now being given in tropical medicine. The excellent index would serve for the notes as well as the text.

As only two pages are given to laboratory methods, it is evident that the doctors in the armed services must look to the notes they have taken in their laboratory courses.

The section on helminthic infections is remarkably satisfactory with its 54 pages. I would question Sir Philip's preference for the generic name *Bilharzia*, which was given the blood flukes by Cobbold in 1859, while Weinland used *Schistosoma* in 1858.

The article on ancylostomiasis is excellent but, in the United States, we are very proud of Maurice Hall's introduction of tetrachlor-

ethylene for mass treatment. Lambert, of the Rockefeller International Health Board, who treated thousands of cases of hookworm disease in the South Sea Islands, using this drug, did not lose a case.

The section on malaria is covered in about 10 pages, and very satisfactorily. New Jersey has a bad reputation for the activities of a culicine mosquito, but it will come to its citizens as a surprise to learn that malaria is "common" in their State.

Our statistics indicate that malaria is more prevalent in our Southern States, and of these Arkansas, Florida, and South Carolina are outstanding.

Chapter VII, on nutritional diseases of the tropics, especially as to beriberi and sprue, is an excellent one.

When Colonel Strong and I first read the article on pinta by Braulio Sáenz, reporting *Treponema carateum*, we were favorably impressed, but when reports came from local surveys in Venezuela and elsewhere of the absence of hyperkeratoses, it seemed best to us simply to report various findings, and not to arrive at any conclusion.

Cases similar to that in which treponemes were found had previously been diagnosed in Havana as syphilitic hyperkeratoses. Moss and Bigelow (1922) studied yaws in Santa Domingo and found clavus (crab yaws) the most common manifestation of yaws in that country. The photographs accompanying the article parallel those from pinta hyperkeratoses in Havana. It should be emphasized that pinta is an extremely important disease in Mexico, Colombia, and Venezuela.

The use of the generic name *Spirochaeta* instead of *Treponema* is preferred by many medical men in Great Britain and the United States, and unjustifiably. Schaudinn named his syphilis parasite *Spirochaeta*, but it was quickly shown that this generic name had been given to two other zoological genera, and Schaudinn recognized his error and renamed the parasite *Treponema pallidum*. In transferring *Treponema carateum* to *Spirochaeta* the neuter specific name has not been changed. This error is frequently made by medical parasitologists in the United States with the parasite of syphilis—the neuter specific name not being changed to agree with the generic name. This is very painful to taxonomists and grammarians.

The sections dealing with virus and rickettsial diseases are to be highly commended and, in particular, the differentiation of amoebic from bacillary dysentery on page 82 is worthy of high praise.

This book is a synopsis entitled to take high rank in the field of "condensed statements and abundant headings, and subheadings".
(E. R. S.)

THE PRINCIPLES AND PRACTICE OF WAR SURGERY, With Reference to the Biological Method of the Treatment of War Wounds and Fractures, by *J. Trueta, M. D., Formerly Director of Surgery, General Hospital of Catalonia, University of Barcelona*; with introduction by *Owen H. Wangensteen, M. D., Minneapolis, Minn.* 441 pages with 144 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1943. Price \$6.50.

Since the appearance of Dr. Trueta's first book, "Treatment of War Wounds and Fractures," much has happened, and the spread of the war has offered many occasions for putting his method and the claims made for it to the test. While rather extensive adoption of the method has proved its value, there remain surgeons who are still averse to encasing wounded limbs in plaster, preferring methods which permit daily examination of the wound. Every item in the five-point procedure must be employed, and the omission of any one may invite failure, viz: (1) Prompt surgical treatment; (2) cleansing of the wound; (3) excision of the wound; (4) provision for drainage; and (5) immobilization in a plaster of paris cast.

Military surgery has developed rapidly since the author's experiences in the recent civil war in Spain. The present volume keeps pace with the advances in this special field. Excellent chapters on shock, transfusion of plasma and the sulfonamides are included. The first part of the book deals with the pathology of war wounds and general care of the wounded. It is an exposition of the underlying principles on which the methods of treatment are based in the second part. All details of treatment represent the fulfillment of the fundamental principles given. Technic is concisely explained and well illustrated.

These methods of treatment can be employed in all conditions by all sorts of surgeons. The quality of results, therefore, is to a large extent independent of the surgeon's skill. In conditions forced upon us by war it is often impossible to direct cases to the appropriate specialist and the surgeon may find it necessary to solve his difficulties himself.

This is an indispensable book for all who have to handle injuries associated with warfare.

TRAUMATIC SURGERY OF THE JAWS, Including First-Aid Treatment, by *Kurt H. Thoma, D. M. D., Professor of Oral Surgery and Brackett Professor of Oral Pathology, Harvard University.* 315 pages with 282 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$6.

The outstanding feature of this book is its illustrations.

The author might have devoted more space to his discussion of first-aid treatment, anesthesia, and chemotherapy, as these subjects are inadequately covered. In view of the present situation, the above phases of medicine are of paramount importance.

The chapter dealing with fractures of the mandible contains many excellent photographs illustrating various methods used in immobilizing these fractures. The chapter on fractures of the maxillae leaves much to be desired. The author spends too much space in classifying these fractures and too little space to their treatment. Traumatic injuries of the condyle and mandibular joint are nicely illustrated and the author has handled this subject very well.

There is very little material contained in this book with the possible exception of the photographs that has not already appeared in other publications.

SYNOPSIS OF TRAUMATIC INJURIES OF THE FACE AND JAWS, by *Douglas B. Parker, M. D., D. D. S., Associate Professor, Department of Oral Surgery, School of Dental and Oral Surgery, Columbia University.* 334 pages with 220 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$4.50.

The increased incidence of accidents in civil life and in the present zones of active military activities together with industrial accidents about the face justifies this reference book. The review of applied anatomy of the face and jaws briefly and adequately illustrates the lines of cleavage of the skin, and blood and nerve supply. The ligation of bleeding vessels and use of the hemostat is emphasized in initial treatment at the scene of the accident together with the importance of controlling respiration. Shock and the management of infection with the use of sulfonamides are briefly discussed. Injuries of soft tissues and the treatment of wounds, particularly gunshot wounds are well handled and illustrated. Types of sutures and their application, burns of the face, and body injuries describing fixation methods with most types of stabilization apparatus in popular use are well depicted. Arthroplasties of the temporomandibular joint necessitated in complications of fractures involving ankylosis are described together with bone grafts. The technic of the Z-plastic flap in surgical reconstruction and other flap types used in graft transplantation to replace lost parts is outlined, as also surgical prosthetic restorations.

Casts and moulages as record aids are described. Local anesthesia, both intra- and extra-orally applied are most desirable for reduction, fixations, and treatment. Roentgenographic technic, bandaging and first-aid treatment for facial injuries, feeding and diet problems, transportation and medicolegal aspect of injuries of the face and jaws are covered in the last paragraphs.

The book is merely a handy reference of contemporary authors and as such serves only as an introduction to the subject matter. Details are wanting. Additional study and clinical experience would be necessary before application of some of the suggested topics could be utilized for advantage to the patient.

FRACTURES OF THE JAW AND OTHER FACIAL BONES. by *Glenn Major, B. S., A. M. (in Pathology), M. S. (in Experimental Surgery), Ph. D. (in Surgery), D. D. S., M. D., F. A. C. S., Pittsburgh;* with chapters on Radiographic Technic, by *Lester M. J. Freedman, B. S., M. D.;* and War Aspects of Jaw Fractures, by *Arthur Dick, D. D. S., M. D.* 446 pages with 225 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1943. Price \$7.50.

Special emphasis in this book, as in other books dealing directly with surgical problems of the face, mouth, and jaws, and of concern to the dentist and oral surgeon, is given to application in emergencies. These emergencies include those occurring at home as well as those on the battle front. The approach seems logical.

The opening discussion of fractures considers the anatomy, pathology and methods of treatments. The author has explained, discussed and illustrated various personal methods of treatments, modifications, and combinations of other forms of treatment. The reviewer does not believe in the extra-oral wiring of the mandible or the various antiquated, intra-oral methods as illustrated and employed to exert force to depress the posterior fragment of the mandible. These forms of treatment often result in osteomyelitis and pressure necrosis. The British and American oral surgeons are having excellent results in the treatment of this type of fracture with the Roger Anderson or similar appliances.

The chapters on anesthesia, their criteria for choice, the values and uses of the x-ray as a diagnostic guide and therapeutic aid are fairly well covered in the text. In the chapter on anesthesia, in the last paragraph on page 106, an almost unbelievable statement is made, namely, that the average oral surgeon does not understand the anatomy of the long buccal nerve. This is a gross misstatement, for not only does the average oral surgeon understand the anatomy of this nerve, but first year dental students are thoroughly trained in the anatomy of the head and neck.

The chapter on diet is most helpful in the treatment of fractures.

TEXTBOOK OF GENERAL SURGERY, by *Warren H. Cole, M. D., F. A. C. S., Professor and Head of the Department of Surgery, University of Illinois College of Medicine;* and *Robert Elman, M. D., Associate Professor of Clinical Surgery, Washington University School of Medicine.* Third edition. 1067 pages; illustrated. D. Appleton-Century Co., Inc., New York, publishers, 1942. Price \$8.

This Textbook of General Surgery presents a comprehensive survey of surgical diseases with emphasis on the clinical aspects of the subject. Admirable as the book is, it cannot by itself entirely fulfill the requirements of either the practicing civilian or the military surgeon on active duty. Supplemented by one or more works now available on surgical technic and procedure, the volume becomes really valuable.

From the standpoint of military surgery the volume is inadequate, but this does not lessen the value of the book since the authors did not

write it for the military surgeon. It is on the whole a definitely worth-while addition to the surgeon's library. As a student text, it is concise and clear and much better written than any other text that has been recently published.

WAR INJURIES OF THE CHEST, by 9 contributors and edited by *H. Morriston Davies, M. A., M. D., M. Ch., F. R. C. S., and Robert Coope, M. D., B. Sc., F. R. C. P.* 131 pages; 36 illustrations. The Williams & Wilkins Co., Baltimore, Md., publishers, 1942. Price \$2.

The redeeming feature of this short work is the accentuation on conservative measures in the treatment of chest injuries; other than this the handbook has little to offer.

The entire outline is elementary; the introductory chapters on anatomy, physiology and pathology are sketchy and inadequate, presenting little of interest. The chapter on penetrating and open chest wounds is the best compiled in the handbook, but the shortcoming of the entire work is manifest still.

A subject so important with all its ramifications could hardly be covered satisfactorily, even in outline form, in a handbook of this character.

RENAL LITHIASIS, by *Charles C. Higgins, M. D., Cleveland Clinic, Cleveland, Ohio.* 140 pages; illustrated. Charles C. Thomas, Springfield, Ill., publishers, 1943. Price \$3.

This book is written by a prominent urologist and covers a specific subject, as its name indicates. It is concise and well written, with good illustrations and on fine grade of paper.

The section on etiology covers 66 out of 122 pages of text and is perhaps the most interesting part of the book. The author quotes many experiments of other men plus much valuable firsthand work of his own, with tables and photographs to illustrate the results of his experiments. Symptomatology, including methods of diagnosis, are excellent, but for practical purposes are of little use to a naval surgeon at sea. The surgical section is brief and covers only 8 pages, plus 7 pages of illustrations. The discussion of diet includes 16 pages of diet charts and would be of value to any physician.

BURNS, SHOCK, WOUND HEALING AND VASCULAR INJURIES, prepared under the auspices of the *Committee on Surgery of the Division of Medical Sciences of the National Research Council.* 272 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$2.50.

A worthy sequel in the series of *Military Surgical Manuals*, this volume is replete with useful information. The sections particularly on burns and skin graft are essentially modern and comprehensive in scope. Shock is discussed thoroughly and the preventive measures are reliable. The military surgeon will find in quick reading all that is necessary for the successful handling of these perplexing problems.

The text is copiously and well illustrated, particularly the section on vascular injuries. Each step in vascular surgery can be confidently and accurately followed from the illustrations alone.

THE PRINCIPLES AND PRACTICE OF OBSTETRICS, by *Joseph B. DeLee, A. M., M. D., formerly Professor of Obstetrics and Gynecology, Emeritus, University of Chicago; and J. P. Greenhill, B. S., M. D., Attending Obstetrician and Gynecologist, Michael Reese Hospital.* Eighth edition, entirely reset. 1101 pages with 1074 illustrations on 841 figures. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$10.

This new eighth edition has been revised and brought up to date in keeping with the ideas of the original author. It remains as one of the outstanding works in obstetrics and can be of use to all interested in the practice of this art from the student to the qualified specialist. The reviser has used his own experience together with contributions by outstanding authorities in the field to make this edition modern and complete in every phase of the subject.

Part I covers the physiology of reproduction, pregnancy, labor and puerperium. The material has been rearranged in more orderly sequence than in previous editions. Hygiene and antepartum care are stressed. Sound advice concerning the diet of the pregnant woman together with vitamin and mineral requirements is given and the responsibility of the physician to the pregnant woman is determined. The importance of careful pelvic mensuration including the use of x-ray with a standard technic is well explained. The mechanisms of labor are simplified in this edition by the use of English terminology and suitable abbreviations for designation of presentation and position rather than adherence to the Latin terms formerly used. The conduct of labor is covered in detail and all types of analgesia and anesthesia with their usefulness in obstetrics are discussed. The author prefers local infiltration anesthesia and explains its use in detail. Continuous caudal anesthesia is given only passing mention.

A section on obstetric and gynecologic endocrinology precedes Part II. This briefly covers the production and effects of the various hormones and their presence in abnormal conditions.

Part II covers the pathology of pregnancy. All abnormalities are adequately considered. The toxemias are classified according to the recommendations of the American Committee on Maternal Health and their diagnosis and treatment are carefully detailed. In both placenta previa and abruptio placentae the use of Willett's forceps is recommended for selected cases. Hospitalization for bleeding cases is strongly advised and the prevention and correction of blood loss are stressed. Erythroblastosis foetalis and its cause, Rh factor, is discussed and the possibility of transfusion accidents in women with anti-Rh agglutinin is mentioned. Anomalies of the bony pelvis are well described, the work of modern writers on the subject being in-

cluded, and the chapters on the mechanisms and management of labor in contracted pelvises are complete. Puerperal infections occupy a large section of the book. Historical data, etiology, types, pathology, etc., are included and treatment is in detail with a comparative estimate of the value of the various sulfa drugs in the different types of the disease.

The final section covers minutely the preparation for and the technique of practically every obstetrical operation. Excellent diagrams simplify the text except in the description of the Waters' extraperitoneal caesarian where photographs are used which are not particularly clear.

The volume is well printed and in general the illustrations are excellent.

GYNECOLOGY, With a Section on Female Urology, by *Lawrence R. Wharton, Ph. B., M. D., Associate in Gynecology, The Johns Hopkins Medical School*. 1006 pages with 444 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$10.

This book gives an adequate presentation of the field of gynecology with special emphasis being given to female urology. It would make a fine textbook for the student as well as reference book for the gynecologist.

Medical gynecology has advanced rapidly in the past few years, partly due to progress made in endocrinology and chemotherapy. The chapter on chemotherapy presents a clear and concise summary of the latest information on this subject. The information relative to endocrinology being so important and interrelated with almost every phase of gynecology may be found dispersed throughout the book. The chapter on sterility gives as fine a coverage of this important subject as can probably be found anywhere.

There has been no neglect of surgical gynecology, however, and operative procedures and surgical principles are well described and nicely illustrated.

The book is beautifully bound and would make a valuable addition to any physician's library.

OVARIAN TUMORS, by *Samuel H. Geist, M. D., Attending Gynecologist, Mount Sinai Hospital; Clinical Professor of Gynecology, College of Physicians and Surgeons, Columbia University*. 527 pages with 312 illustrations. Paul B. Hoeber, Inc., New York, publishers, 1942. Price \$10.50.

The author has given complete coverage to this extremely interesting subject. He has carefully reviewed his own wide experience and has studiously combed the vast literature on ovarian neoplasm.

In order to develop the material properly he starts with the embryology of the ovary and the reader is then taken through complete descriptions of its anatomy and physiology. Hormone therapy and

the interrelations of the ovary and other endocrine organs are briefly discussed. The chapter considering the subject as a whole is extremely interesting, with several classifications of ovarian tumors, including one offered by the author, listed along with a wealth of general information. Each type of ovarian tumor is then taken up in detail with a careful description of its pathologic anatomy both gross and microscopic, a brief discussion of its clinical significance, and a short general statement in regard to its treatment.

Ovarian tumors in children and parovarian tumors are discussed briefly, and the matter of pregnancy with associated ovarian tumors is covered thoroughly, and the recommended methods for handling this complication are definitely stated. This section is very practical and will be of value to all clinicians, as will the two final chapters which consider in detail the manner in which the diagnosis of ovarian tumor is made and how it should be treated once the diagnosis is made.

The book is well written, printed with clear type on heavy paper, making it easy to read, and is well illustrated. It covers the subject matter completely and could well be used by both instructor and students of the subject.

PRINCIPLES OF EXTRAPERITONEAL CAESAREAN SECTION, by *James V. Ricci, A. B., M. D.*, Associate Clinical Professor of Gynecology and Obstetrics, New York Medical College; and *James Pratt Murr, M. D., F. A. C. S.*, Associate Attending Surgeon, Woman's Hospital in the State of New York. 224 pages. The Blakiston Co., Philadelphia, Pa., publishers, 1942. Price \$4.50.

The authors have produced an excellent book, interestingly written and containing a few well chosen illustrations. The field of extraperitoneal section is covered in its entirety from a historical background. The authors have also put together a résumé of each type of operation with sufficient explanation for practical use.

The Latzko and Waters operations are given in detail with appropriate illustrations from the originals. The authors then proceed to present their operation, with the argument that the gravid uterus changes the bladder into an abdominal organ. With this change there is formed an avascular space bounded by the bladder below, by the peritoneal fold above, the prolongation of the fascia vesicae anteriorly and the lower uterine segment posteriorly. Outlining the bladder with a curved catheter, the fascia uteri can be cut across and this space entered in order to reach the lower uterine segment entirely extraperitoneally, without injury to the bladder or peritoneum. The remainder of the authors' operation is standard for lower segment caesareans.

The book has unquestioned value in its presentation of this subject. Whether the authors' operation is as practical for most operators as other extraperitoneal operations is doubtful. However, it is

presented in such a way that a good operator certainly will find it of value.

DISEASES OF THE NOSE, THROAT, AND EAR, Medical and Surgical, by *William Lincoln Ballenger, M. D., F. A. C. S., Late Professor and Head of the Department of Otology, Rhinology, and Laryngology, School of Medicine, University of Illinois, Chicago; and Howard Charles Ballenger, M. D., F. A. C. S., Associate Professor of Otolaryngology, Northwestern University School of Medicine, Chicago.* Eighth edition, thoroughly revised. 975 pages; illustrated with 604 engravings and 27 plates. Lea & Febiger, Philadelphia, Pa., publishers, 1943. Price \$12.

This is the eighth edition of a well-written book on the ear, nose, and throat. It is to be regretted that the excellent black and white illustrations are not augmented by color plates of equal quality and number, especially those of the larynx, as well as those of the tympanic membrane, which are not well represented.

Detailed information on many procedures have been given so that the general practitioner, as well as the specialist, can follow them with ease.

The chapter on physiology, functional tests and inflammatory disease of the labyrinth by Dr. Alfred Lewy is especially well written, as are the chapters on paralysis and neurosis and operative procedures for paralysis of the larynx.

The material in this volume, all in all, has been well covered for so varied a subject as ear, nose, and throat, and several often neglected fields of this specialty have been brought to the fore.

The printing is excellent and on good stock with a serviceable binding.

CLINICAL CARDIOLOGY, With Special Reference to Bedside Diagnosis, by *William Dressler, M. D., Attending Cardiologist, Israel Zion Hospital; Assistant Attending Physician, Brooklyn Hospital, New York.* 692 pages with 108 illustrations. Paul B. Hoeber, Inc., New York, publishers, 1942. Price \$7.50.

This book is well written, concise, and arranged systematically, as well as complete in every detail, including the illustrations.

It is written to emphasize the older and simpler diagnostic methods of clinical observations. The author wishes to develop in students and readers this art and not to depend on complicated apparatus and laboratory technic. He also points out the danger of overemphasis of diagnosis made by these methods. He says that in the field of prognosis, evaluation of electrocardiographic data has done more harm than good.

He has the latest viewpoints on most subjects, especially in regard to pathogenesis of hypertension and natural history of rheumatic infections.

The book is meant mostly for senior students, young graduates, and general practitioners and will prove very popular with them. It is a good contribution to cardiological literature.

CLINICAL PEDIATRICS, Oxford Medical Outline Series, by *I. Newton Kugelmass, M. D., Ph. D., Sc. D., Attending Pediatrician, Downtown Hospital, Pan-American Clinic, Heckscher Institute, New York.* 393 pages. Oxford University Press, New York, publishers, 1943. Price \$2.

This volume is a continuation of the Oxford Press series and as such carries through admirably the projected plan of the subjects treated in brief outline form. It is a digest of "child healing" and purposes to orient the student and practitioner with all the aspects of pediatrics. As a systematic survey of the field, it presents the grist of larger volumes in such a manner as to prove definitely timesaving and helpful.

The reviewer is particularly impressed with the comprehensive up-to-date and modern therapeutics enumerated for the diseases outlined.

DISEASES OF THE SKIN, by *Oliver S. Ormsby, M. D., Rush Professor of Dermatology, University of Illinois; and Hamilton Montgomery, M. D., M. S., Associate Professor of Dermatology and Syphilology, Mayo Foundation for Medical Education and Research, Graduate School, University of Minnesota, Rochester, Minnesota.* Sixth edition, thoroughly revised. 1,360 pages with 654 figures containing 423 illustrations and 6 colored plates. Lea & Febiger, Philadelphia, Pa., publishers, 1943. Price \$14.

The sixth edition of this book which has long been recognized as an outstanding treatise on this subject has attained an unusual degree of perfection due to the addition of a short clear synopsis of the microscopic findings of each disease wherever such information would be of value. The microscopic findings are by Hamilton Montgomery and they cannot be too highly praised.

In order to maintain a book of reasonable size, the authors have regrouped a large number of diseases, added 22 diseases not previously described in this text, rewritten many others, and discarded entirely two classes of diseases that have been made obsolete through recent discoveries. In writing excellent chapters on anatomy and physiology and on general pathology, they have recognized the necessity of knowing these subjects thoroughly before one can fully appreciate the clinical and microscopic aspects of skin diseases.

The book is attractively bound, compact, and printed on excellent paper which has enabled the publishers to reproduce clearly and exactly the large number of clinical and microphotographs with which the text is so profusely illustrated. Syphilis with all the newer aspects of its treatment is adequately covered in 78 pages.

This book will be as valuable to the trained dermatologist as it will be to the student or the general practitioner.

MANUAL OF OXYGEN THERAPY TECHNIQUES, Including Carbon Dioxide, Helium, and Water Vapor, by *Albert H. Andrews, Jr., M. D., Director, Oxygen Therapy Department and Assistant Attending Otolaryngologist, St. Luke's Hospital, Chicago, Ill.* 191 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., publishers, 1943. Price \$1.75.

This volume contains, in almost painful detail, a description of the methods and equipment used in the therapeutic administration of oxygen. The material is well arranged and printed in easy type on good paper. Illustrations and photographs are adequate and good.

After a short chapter on the physiology of respiration, the various sizes and types of gas containers and regulators are described and directions given for maintenance and testing of equipment. The advantages and disadvantages of the tent, catheter, and mask methods of administration are discussed in detail and illustrated by tables and by photographs of equipment in use. Each type of tent and mask is taken up separately and their technic of operation and their merits and faults listed. The therapeutic use of carbon dioxide, helium, and water vapor are also discussed.

This handbook gives a very full description of the technic of oxygen therapy and should be a very handy reference book on this subject.

A TEXTBOOK OF CLINICAL NEUROLOGY with an Introduction to the History of Neurology, by *Israel S. Wechsler, M. D., Clinical Professor of Neurology, Columbia University, New York.* Fifth edition, revised. 840 pages with 162 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$7.50.

The general excellence of Wechsler's textbook of neurology is well recognized. The fifth edition is geared for action and many important practical things have been added and some others eliminated. Wechsler's approach to the clinical entities leaves little to be desired. The section which deals with the treatment of the meningitides is an indication of the advances resulting from the new chemotherapy and the influence on prognosis. The chapter on the affections of the autonomic nervous system is particularly noteworthy. The chapter entitled "Introductions to the History of Neurology" is very interesting. It details the trials and tribulations which attended the birth of neurology as a specialty. Neurology has a great future and it behooves students to become acquainted with its past.

The field of neurology has become so vast that many things formerly carried in a textbook of this type must be sacrificed. One would almost wish that Dr. Wechsler had sacrificed the chapter on neuroses. He has covered that subject very well in another volume and it does not seem to fit in this one. Most neurologists and psychiatrists will disagree with his espousal of the cause of lay analysts.

In general Dr. Wechsler's book is complete, well presented, and interestingly written. The illustrations are well chosen and the book is to be highly recommended.

COMPENDIUM OF REGIONAL DIAGNOSIS IN LESIONS OF THE BRAIN AND SPINAL CORD, A Concise Introduction to the Principles of Localization of Diseases and Injuries of the Nervous System, by *Robert Bing, Professor of Neurology, University of Basel, Switzerland*; translated and edited by *Webb Haymaker, Assistant Clinical Professor of Neurology and Lecturer in Neuro-anatomy, University of California*. Eleventh edition. 292 pages with 125 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$5.

This volume by Professor Bing of Basel, Switzerland, has been an authoritative text for over 30 years. Ably translated by Dr. Haymaker, it provides a very readable and useful supplement to the usual textbook of clinical neurology.

The symptomatology, diagnosis, and differential diagnosis of lesions occurring in all regions of the brain and spinal cord are fully covered in a concise and orderly fashion. The outstanding feature of the volume is its clarity, a quality particularly to be desired in the presentation of material which by its nature is complicated and often confusing.

Students should find it useful in making the transition between neuro-anatomy and physiology, and clinical neurology. For others it is useful as a reference or review text, as the subject matter is practical and sound, and the format makes the excellent outline and its subheading readily available at a glance. There are 125 illustrations, 27 of them in color, and 11 tables. Sections on encephalography and myelography have been added by Dr. Haymaker in this edition, with 7 plates of roentgenograms illustrating typical diagnostic features.

INTRODUCTION TO PSYCHIATRY, by *W. Earl Biddle, M. D., Senior Physician, Warren State Hospital; Mildred van Sickel, B. S., R. N., Instructor of Nurses, Warren State Hospital, Warren, Pa.*; with a foreword by *William C. Sandy, M. D., Director, Bureau of Mental Health, Pennsylvania Department of Welfare*. 358 pages with 38 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$2.75.

This book endeavors to present psychiatry in a simple manner. The material is well organized; the print is easily read; and the style is written in a concise and practical manner. The book is divided into two main sections. The first section deals with the principles of psychiatric nursing, and the second is concerned with clinical psychiatry in relation to psychiatric nursing.

The chapters dealing with psychiatric nursing are excellently done. Abnormal behavior and the means available to deal with it are well covered. The technic of various treatments is explained in detail,

thus making a good reference book. The chapters which deal with clinical psychiatry are not as practical as the early chapters. Although the material is brief and concise, at times it seems too complicated for understanding by personnel other than physicians. The dynamic factors in a few psychiatric case illustrations might arouse more interest on the part of a psychiatric novice.

The book achieves its purpose. It is a book which should be of interest to anyone who deals with patients. However, it is an excellent presentation for the personnel responsible for the daily treatment of psychiatric patients. At the present time, it could serve as an excellent reference and textbook for the teaching of hospital corpsmen. It is an essential adjunct to a medical library and offers a useful addition for the teaching of psychiatric nursing to all personnel.

NEUROSURGERY AND THORACIC SURGERY, prepared and edited by the *Subcommittees on Neurosurgery and Thoracic Surgery of the Committee on Surgery of the Division of Medical Sciences of the National Research Council*. 310 pages, illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$2.50.

This last volume of the series presented under the direction of the National Research Council maintains the high tone and general excellent informative character of the preceding volumes. In some respects the section on neurosurgery appears more comprehensive; its definite practical attitude gives the treatise a superiority over most of the books constituting the series. The war surgeon faced with neurological battle problems should feel more composure in the handling of such injuries after careful perusal of the present volume.

The subject of thoracic surgery is handled much too briefly, and lacks the detailed practical approach found in the earlier chapters on neurosurgery. Realization of the prevalence of chest injuries in battle wounds should elicit a more comprehensive and pertinent discussion of the problems involved.

The volume throughout its pages is generously and excellently illustrated.

OUTLINE OF PSYCHIATRIC CASE-STUDY, A Practical Handbook, by *Paul William Preu, M. D., Assistant Professor of Psychiatry and Mental Hygiene in the Yale University School of Medicine*; with a foreword by *Eugen Kahn, M. D.* Second edition, revised and enlarged. 279 pages. Paul B. Hoeber, Inc., New York, publishers, 1943. Price \$2.75.

Revised and enlarged, the second edition of this book presents an outline and a method of proceeding with a psychiatric study which represents in general that used by the Department of Psychiatry and Mental Hygiene of the Yale University School of Medicine. It is recommended to those entering the field of psychiatry and those interested in the methodology of this field of medicine. It contains in an eminently practical and detailed manner the actual technic of elucidat-

ing the various factors contributing to personality development. The inclusion of the charts dealing with the general medical history, physical examination, and nursing are perhaps superfluous while the detailed case study of the child is repetitious though intended to be used independently of the outline for study of the adult.

The book is well bound with paper cover, and is easily read due to the rough finish. The index is adequate. There are no illustrations.

CLINICAL DIAGNOSIS BY LABORATORY METHODS, A Working Manual of Clinical Pathology, by *James Campbell Todd, Ph. B., M. D., Late Professor of Clinical Pathology, University of Colorado, School of Medicine; and Arthur Hawley Sanford, A. M., M. D., Professor of Clinical Pathology, University of Minnesota (The Mayo Foundation), Head of Division on Clinical Laboratories, Mayo Clinic.* Tenth edition, thoroughly revised. 911 pages with 380 illustrations, 32 in color. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$6.

This new tenth edition represents a well-balanced and up-to-the-minute presentation of the various methods and procedures used in a modern clinical laboratory.

The authors present the most authoritative procedures applicable to the busy physician's own laboratory. Furthermore, the valuable interpretations of the laboratory findings aid the physician in making a bedside diagnosis.

This edition includes such new tests and improved technics of standard procedures as: Determination of sulfonamides and sulfones in the blood; identification of sulfonamide crystals in the urine; various photolometric methods; the Mazzini test for syphilis; the Quick prothrombin test.

Two very important and valuable features of the text are: (1) The excellent discussion of solutions for intravenous use, in the Appendix (p. 836), and (2) the index outline of Laboratory Findings in Important Diseases.

This book continues to represent one of the best presentations in methods, procedures, and interpretations of clinical pathology for the student, laboratory technician, pathologist, and physician.

A TEXTBOOK OF BACTERIOLOGY, by *Thurman B. Rice, A. M., M. D., Professor of Bacteriology and Public Health at the Indiana University School of Medicine.* 560 pages; illustrated. Third edition, revised. W. B. Saunders Co., Philadelphia, Pa., publishers, 1942. Price \$5.

Physicians and students alike find "A Textbook of Bacteriology" by Dr. T. B. Rice, widely known lecturer and author, a valuable and up-to-date guide to bacteriology. With its easy, readable style, and its good organization of material, it should prove especially worth while to the beginner.

The volume is essentially a review of available literature on bacteriology, and the author has exercised care in his choice of subject

matter. The chapter on chemotherapy and prophylaxis of many organisms is worthy of special mention.

A wealth of valuable information is set forth in the study of bacterial culture methods, while the article on etiology of dental caries represents a summary of the newest thought on this subject. It is unfortunate, however, that the author neglected to furnish sufficient illustrations. There are a number of places where diagrams might have been used to amplify or substitute for the text.

Advice to physicians to buy prepared stains, except in the case of a large laboratory, and to supply paper napkins for patients with a nasal secretion, appears to be sound. However, the assertion that sulfanilamide and related drugs should be used in all cases where there is no definite contraindication to their use is open to dispute in the reviewer's opinion.

The statement that mixed stock vaccines are not believed to be useful in the prevention and treatment of colds will probably go uncontested. The writer holds that they may immunize against secondary infections, but even that is doubtful.

The book contains a complete classification of diseases spread by filth, discharges, contact, and the bites of insects. In addition, there is an excellent table showing differential points between hard and soft chancre.

The author reiterates that syphilis is still the greatest public health problem because his interest lies primarily in that sphere.

The clinician will not derive much information in the actual care of patients. The work is not sufficiently inclusive to serve as a reference.

TEXTBOOK OF BIOCHEMISTRY, by Benjamin Harrow, Ph. D., Professor of Chemistry, City College, College of the City of New York. Third edition, revised. 537 pages with 118 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$4.

This third edition again emphasizes the value of this work, not only as a textbook, but as a succinct review of biochemistry for the medical officer. All of the material in the text appears to have been thoroughly surveyed with a considerable expansion of many sections. The general character and purpose of the book remain unchanged but a notable effort has been exerted to analyze and evaluate later developments and their significance. In fact, there is evidence of a searching and painstaking revision throughout the whole text. An entirely new chapter has been added to this edition under the caption: "Immunochemistry and Chemotherapy." The author points out that this was prompted by the spectacular clinical results obtained with the sulfa drugs and arsenicals; and the resultant surge of interest in the biochemical aspects of these subjects. •

Among the changes noted, the following are among the more significant: Nylon in the expanded discussion of polypeptides; fuller treatment of viruses with new electron micrographs; expansion of the field of enzymes and their functions; enriching of foods and nutritional problems of the war period; extensive expansion of the chapter on vitamins; blood plasma and the war; extensive revision of the hormone chapter to include the origin of thyroxine, new matter on diabetogenic hormones, stilbestrol, and inducing of cancer by chemical compounds; renin and hypertension; physiological activity and sulfhydryl group; break-down and synthesis of glycogen in animal tissues; and newer views on acetone bodies, exogenous and endogenous metabolism, and the origin of creatine.

FOOD POISONING, by *G. M. Dock, Ph. D., M. D., Associate Professor of Bacteriology, The University of Chicago.* 138 pages. The University of Chicago Press, Chicago, Ill., publishers, 1943. Price \$2.

This brief and concise work will be the answer to many questions arising in the minds of medical officers making their first investigations of outbreaks of "food poisoning."

First the writer points out the importance of investigation—early investigation, giving helpful ideas for the methods to be followed in lay practice. With this foreground he plunges the reader headfirst into the vague subject "food poisoning," from which he emerges with the modern concept of chemical poisons in foods, poisonous animals and plants, bacterial toxins in foods, and food-borne infections. For those who know the field it is a refreshing review. For those to whom the subject is new or confused, it is a timely source of authoritative information which a busy physician can cover and assimilate in a few hours.

PUBLIC HEALTH STATISTICS, by *Marguerite F. Hall, M. A., Ph. D., Assistant Professor of Public Health Statistics, School of Public Health, University of Michigan.* 408 pages. Paul B. Hoeber, Inc., New York, publishers, 1942. Price \$5.50.

Research in public health today depends almost as much on statistical technics as on laboratory test-tube methods. This is due, in part, to an increasing exactness in medical science, enabling a certain amount of quantitative measurement, and in part, to a growing recognition of the very great contribution of mass data, treated statistically.

Recognition of this fact has stimulated a considerable development not only in the refinements of statistical theory but in the methods of application, e. g., more efficient methods and better machines for the tabulation of data, for the registration of facts, for the taking of censuses, and for the facilitating of statistical analyses. In other words, the subject of statistically treating public health data has become an extremely active, stimulating, and significant branch of

medical science, in its broadest sense, and now makes a definite claim as an important part of any curriculum dealing with matters of public health and welfare.

It is therefore particularly welcome to find a volume as timely, complete, and accurate as the one by Dr. Hall on Public Health Statistics. Among its 21 chapters covering the entire range of the subject are such topics as Measures of Reliability, Theory of Probability, Measures of Relationship and Trend, Measures of Variability, Measures of Central Tendency, Mass Data, Construction of a Life Table, Variation and Trends in Rates, Vital Statistics, Graphical Presentation, Tabular Presentation, etc. Add to this the attraction of a simple, direct, and interesting style, studded with apt examples, analogies, and illustrations, and you have what this book is—a first-class handbook for beginners and advanced students alike on public health statistics.

CIVILIAN HEALTH IN WARTIME, by Francis R. Dieuaide, M. D., Associate Professor of Medicine, Harvard Medical School, Massachusetts General Hospital. 328 pages. Harvard University Press, Cambridge, Mass., publishers, 1942. Price \$2.50.

The goal of improved rather than impaired physical and mental health during the war is the theme of this informative volume. The emphasis is upon positive qualities of strength and vigor, rather than mere absence of disease. While in no sense a text, this book is, nevertheless, a valuable contribution to the source material available to the layman, on the social implications of good programs of preventive and curative medicine, and his own responsibilities in and for them.

The concrete problems of nutrition, proper wartime housing and apparel, the prevention of infectious disease, maternal and child health and that of the aged, and the adjustments in work and recreation necessitated by the war are discussed. There is an interesting chapter dealing with the profession's task in maintaining the standards of medical care during this emergency, with some consideration of how the patient can be best helped to meet its cost, both now and in the future. The section on mental health and morale emphasizes that mental disorders are common human failings, which are preventable and treatable in many instances, a reassurance which seems to have particular significance under the stresses of war.

Its clear, direct style and excellent typography make this book easy reading. It is well indexed and annotated, and contains a classified bibliography, suited to the needs of the reader who may wish to pursue further the thinking suggested by the author.

THE DIVISION OF PREVENTIVE MEDICINE

Commander T. J. Carter, Medical Corps, United States Navy, in Charge

THE DISINFESTATION OF SHIPS BY FUMIGATION ¹

HAROLD E. JENNINGS

Lieutenant H-V(S) U. S. N. R.

The extermination of pests aboard ships and the prevention of reinfestation presents problems that are not met in handling the same type of work ashore. The methods must vary because of the marked dissimilarity in living spaces.

Under no circumstance should a ship or any part thereof be fumigated by an inexperienced crew. Where a civilian contractor is engaged to handle the fumigation he should be supplied with the following information: (1) Insects or rodents to be exterminated; (2) sections of the ship to be fumigated; (3) number of cubic feet in the sections to be fumigated; (4) dosage (number of pounds of gas to be used per thousand cubic feet); (5) location of the ship to be fumigated; and, (6) day and hour the ship will be available and the time allowed for completion of the work (including aeration and testing for presence of gas after exposure).

The damage-control officer of the ship together with the medical officer should confer with the contractor before the fumigation is to take place. The contractor should be fully conversant with entrances and exits in the section of the ship to be fumigated, so that he may plan the work with greatest safety to his workmen and the naval personnel.

The contractor should be required to furnish a list of men who will be used to handle the work involved, with complete details regarding the personal history of each man. Only American citizens should be used in the performance of the work and any employee not completely acceptable to O. N. I. shall be replaced by another employee who is.

The contractor should also be required to outline the procedure required for fumigation of the vessel. It is the duty of the medical, executive, and damage-control officers to inspect the work of sealing, closing of ports, ventilating shafts, watertight bulkheads, etc., to be

¹ Received for publication May 27, 1943.

certain that there will be no leakage of gas into compartments of the ship other than those ordered fumigated.

The medical officer should also inspect to be certain that all living plants and animals in the "danger area" of the fumigated section are removed, together with all liquid foods and dairy products; food commodities with high oil content; all moist foods not in airtight containers; dry foods that will be used within 3 days after the fumigation; fresh fruits and vegetables; medicines or chemicals that might react with hydrocyanic acid gas; unexposed photographic films and photographic papers; and service gas masks of the crew. On rare occasions hydrocyanic acid gas has been found to affect clocks and sensitive mechanical instruments after long exposures and heavy dosages. Where such dosages and exposure are contemplated, chronometers should be protected or removed before fumigation.

On the day of fumigation the contractor should personally appear at the ship and vouch for each of his men as they go aboard. Hydrocyanic acid gas or other fumigants must be brought to the dock in original cases as received from the manufacturer. No gas or other fumigant not so contained is to be allowed to be taken aboard ship.

The executive officer should personally be responsible for seeing that an armed guard is posted at all times on the dockside, that proper relief is provided, and that such guard remain constantly on duty until proper chemical tests have been made to determine that the ship is in a gas-free condition and is safe for the personnel to return aboard. The guard will challenge any person attempting to board ship with the exception of the contractor's workmen.

Appropriate armed guards will also be placed in such position as to watch the waterside of the ship away from the dock to prevent any person from attempting to board her who might be unaware of the danger. This guard should be carefully selected and should be informed of the danger of going aboard the ship during fumigation.

Before the gas is released, the executive officer or damage-control officer, together with the medical officer and the contractor, must personally inspect all sections of the ship, especially those to be fumigated and in the adjacent "danger areas," to be certain that all persons and material which might be damaged by the gas have been removed. Every part of the ship should be visited on this inspection, and during the period of the inspection the guard at the dock side will permit no one, not even employees of the contractor, yard officials, or naval personnel, to board the vessel.

The prescribed quantity of hydrocyanic acid gas or other fumigant is then released by the contractor or his employees, who wear appropriate gas masks. Under no circumstances should the con-

tractor and his employees be allowed to handle fumigating gases aboard ship without proper gas-mask protection. Service masks must not be used for this purpose. Fumigating gases require the use of masks with specially constructed canisters. The masks and canisters to be used for such purpose should be those recommended by the United States Bureau of Mines and appropriately marked for use with the various gases.

The contractor leaves at least two of his employees at the shipside at all times during the exposure of the gas in the ship and those employees should have proper masks at hand. No persons will be permitted to sleep aboard ship until a period of 12 hours has elapsed after the contractor has pronounced the ship gas free. The contractor must make suitable tests in the presence of the medical officer with methyl orange paper or other suitable testing materials to prove the gas-free status of the ship.

The methyl orange-mercuric chloride test is sensitive to a concentration very much lower than the minimum lethal concentration of HCN. It requires 2 minutes to complete its reaction, which allows for an error of a few seconds in reading the time factor without materially affecting the calculations. It is made with a comparatively dry filter paper which can be prepared in advance at a convenient place and will keep under proper conditions of humidity for 30 days.

The test is accomplished by lowering a strip of test paper into the hold by means of a clip and string, thus avoiding danger to the operator through exposure to HCN gas. The apparatus necessary is a string and clip, a dark container with a supply of test papers, and two small glass vials, one carrying the immediate supply of test paper and one containing a single test paper for comparison. When desirable, the test paper can be carried into a room or compartment in a small vial and then exposed for the desired length of time. In this test a 10 percent error in noting the time of exposure would not materially affect the resultant calculations.

Chloropicrin reacting slowly with test paper will not interfere with the practical operation of the test when fumigants containing this ingredient are used.

As the time of exposure necessary to produce a reaction is shortened as the humidity increases, too much credence should not be placed in this test if used during rain or fog.

It is apparent that this test depends upon a judgment of color for its accuracy, and considerable laboratory care is essential in preparing and maintaining the test papers at a fairly constant moisture content. For these reasons it is not believed that the test can completely replace the tests of smell, taste, and lacrimation used by

commercial fumigators. (Under laboratory conditions, working with known quantities of HCN it has been established that the sense of smell could detect 0.25 cc. of liquid HCN per 1,000 cubic feet of air space, or approximately $\frac{1}{280}$ of the standard concentration used in ship fumigation.) It is to be noted that the tests of smell, taste, and lacrimation can only be effectively applied by experienced fumigators, and in work done for the naval service chemical testing should be required.

Owing to the fairly high atmospheric humidity at most seaports an error in this test will probably be on the side of safety, which would result only in a slight delay in the clearing of vessels.

TABLE 1.—Results in using test papers

Grams HCN per 1,000 cubic feet	Proportion of standard ¹	Duration of test in minutes				
		$\frac{1}{2}$	1	$1\frac{1}{2}$	2	3
6.7	$\frac{1}{40}$	Slight pink at edge.	Faint pink.....	Definite pink...	Red.....	Red.
3.35	$\frac{1}{80}$	No change.....	Slight pink at edge.	Faint pink.....	Definite pink...	Do.
1.675	$\frac{1}{40}$	.....do.....	No change.....	Brownish orange.	Faint pink.....	Faint pink.
.8375	$\frac{1}{80}$	.....do.....	.....do.....	No change.....	Slight pink.....	Very faint pink.
.4187	$\frac{1}{160}$	.....do.....	.....do.....	.....do.....	No change.....	No change.
.2093	$\frac{1}{320}$	.....do.....	.....do.....	.....do.....	.....do.....	Do.

¹ The word "standard" indicates 2 ounces HCN per 1,000 cubic feet of air space. 3.35 gm. of HCN per 1,000 cubic feet is estimated as the minimum lethal dosage and a 12-hour exposure. 3.35 gm. of HCN gas is therefore taken as the maximum allowable HCN content for safety.

Tests made have shown that test papers under atmospheric conditions of between 70 percent and 75 percent relative humidity, give practical results for a period of 2 weeks after their preparation.

In order to prepare the test papers two stock solutions are first made. Solution No. 1 contains 1.25 gm. of mercuric chloride in 250 cc. of distilled water. Solution No. 2 contains methyl orange 0.60 gm. in 250 cc. distilled water. Ten cc. of the mercuric chloride solution is mixed with 5 cc. of the methyl orange solution and 1 cc. of glycerin is added.

Sheets of filter paper are immersed in this solution and hung up to dry in air which is free from any trace of acid. When dry they are cut into strips $\frac{1}{4}$ -inch wide and preserved in glass tubes protected from the light.

Table 1 gives comparative results in using these test papers.

It is the sole responsibility of the contractor to determine when the ship is safe for return of the personnel. The medical officer and executive officer are guided by the contractor's advice with reference thereto.

In naval vessels of the modern type which employ the "citadel" in their construction, the damage-control officer or executive officer makes certain that the contractor understands the construction and use thereof before the fumigation is begun.

The damage-control officer also informs the contractor concerning the ventilating ducts and other means of expelling the gas from the fumigated area that might be used in exhausting the gas after the exposure time of the fumigation. Particular attention should be called to ventilating ducts which may take air or gas from the fumigated area into other unfumigated areas in the ship and particular notice should be made of such intercommunicating ducts. They should be properly sealed so as to avoid loss of gas in the fumigated area and the danger of introducing such gas into unfumigated areas of the ship.

The contractor should supply the Bureau of Supplies and Accounts with certificates of insurance before the contract is awarded. These certificates should testify that the contractor is fully covered by workmen's compensation insurance applicable to the city in which the work is being performed and that he is also covered by public liability insurance with minimum limits of \$25,000 and property damage insurance with minimum limits of \$10,000.

Fumigation of ships by means of hydrocyanic acid undoubtedly is the most-satisfactory method of exterminating such insects as bedbugs, fleas, and lice, as well as rats and mice. Fumigation with hydrocyanic acid gas stops all work on the ship and while it is in progress all of the crew must be removed.

The technic of ship fumigation entails the following procedure:

1. Surveying the ship and determination of dosage.
2. Preparation of the ship for fumigation.
3. Setting the gas.
4. Aeration after the period of exposure to gas has elapsed.

The ship should be divided into separate sections which should be treated as separate units for fumigating purposes. In order to do this the ventilating system should be studied and the location of watertight doors and companionways noted so that one section of the ship may be isolated from another section where necessary. Open pipes and ventilator shafts leading through bulkheads should be carefully checked, as proper sealing of the ship will require that these be sealed on the inside of the hull. A survey of holds, double bottoms and insulated areas will be necessary in order to divide the ship into suitable sections for fumigation. Hatchways, companionways, and watertight doors leading from one fumigation section into an adjacent section of the ship should not be considered as making the fumigated area gas tight. All holds adjacent to the fumigated areas

should be considered to be "danger areas" and should if possible be kept constantly ventilated during the fumigation. The various sections should be carefully measured for volume and the quantity of gas required calculated on the basis of 8 to 10 ounces per 1,000 cubic feet for the destruction of insect pests, and 2 ounces per 1,000 cubic feet for the extermination of rats. In estimating the amount of cubic space of cargo vessels or ships in the Fleet train, use may be made of the capacity plan of the vessel. The figures which are known as "grain skin capacity" are usually satisfactory for this purpose.

The preparation of the ship for fumigation is just as important as the fumigation operation itself, since careless sealing or improper closing of air ducts will cause the work to fail. Water bottles or water tanks in the danger area should be emptied. Portholes should be closed and properly dogged down. All ventilating communications with the fumigated sections should be closed by means of tight-fitting canvas covers. Attention must be paid to the various air extractor units and to suction or forced-draft fans. In addition, if the engine rooms are to be treated, funnels should be covered to eliminate any chimney draft. Sealing of the funnels is more important in the case of oil-burning ships which may not be provided with chimney dampers. Bilges should always be pumped before the holds are fumigated.

Fire hoses should be laid out on the deck and on the dock and should be connected to a standpipe on the dock. The captain of the yard and the local fire department are to be notified of the time that the gas is to be set and the time of aeration. Boilers should be shut down and all fires extinguished. A notice board to prevent craft from mooring alongside should be placed on the offside of the ship. This notice should state that the vessel is under poison gas and a similar warning board should be posted at the foot of the gangway. The exterior of the hull should be examined to insure that no portholes are left open in the fumigated areas and that no ropes or ladders are hanging over the side. Before setting the gas the responsible officer should see that all inside doors are opened and that there is a key for every door, available to the fumigating crew. Fumigating gas should never be discharged into a ship in which any door is locked. This is especially true of transports and ships in the Fleet train where living quarters might be individually locked.

No fumigator is to be allowed to work alone in any fumigation area, and no member of the fumigating crew is to be allowed to board the ship without gas mask adjusted and ready for use.

Prior to release of any gas, a rescue belt for hauling injured or unconscious persons from the hold should be conveniently placed on the deck and a strong rope made available at each hatch. In place

of the rescue belt a small cargo sling with steel rings at each of the four corners may be substituted. An unconscious person can be rolled onto such a sling and the rope passed through the rings to hoist him. It shall be the duty of the medical officer in charge to make certain that the contractor has proper first-aid materials at hand before the release of the gas. These first-aid materials should include:

- 12 pearls of amyl nitrite.
- 2 ampules of sodium nitrite.
- 2 ampules of sodium thiosulfate.
- 1 sterile syringe, 10-cc.
- 1 sterile syringe, 50-cc.
- Aromatic spirits of ammonia.

Quarantine regulations now require that one-half hour before the main charge of HCN is placed in the ship there shall be sprayed into its holds a small amount of chloropicrin ($\frac{1}{20}$ ounce per 1,000 cubic feet). This is an effective tear gas, the use of which has, on several occasions, driven out stowaways who had not been detected during the inspection of the ship.

When the warning period has passed, during which the chloropicrin has been allowed to disperse throughout the spaces of the ship, HCN gas is then introduced. The first step is to blow it into those confined spaces which cannot be opened sufficiently to insure gas penetration. A simple method of blowing gas in is to have a can of powdered calcium cyanide and a footblower. Then the gas containers are opened on deck and the gas simply shaken into the hold. Tarpaulins are drawn over the hatches and fastened down around the edges.

In the superstructure of the ship a sufficient number of tins of the gas is placed in compartments and alley ways to treat as large a unit as possible, all communicating doors naturally being opened.

The operators work in couples scattering the contents of the tins evenly on canvas sheets or paper runners. They then leave the fumigated area by means of the prearranged exit door, after which it is sealed. The distribution is begun at the farthest point from the exit with the operators working toward the outlet in each section. Thus exposure to heavy concentrations of gas is avoided. The work proceeds in similar manner until all of the sections are under gas. Careful examination should be made to insure against leakage. However, in the event of any leakage being found, fumigators are prohibited to return to the fumigated section to secure the leak or for any other purpose.

After the predetermined period of fumigation the upper decks are opened first, funnel cloths removed, engine room ventilators uncovered, and skylights opened. The cowl ventilators should be properly trimmed to facilitate aeration, the damage-control officer advising as to the best means to this end,

All openings in the ship reached from the topside which facilitate ventilation are opened on the leeward side first, followed by those to windward. When all openings reached from the deck are released, ventilation is allowed to proceed for 2 hours before any further work is undertaken.

After 2 hours have elapsed, the men working in pairs open port-holes and ventilators on the lee side of the next lower deck followed by those on the windward side. It is important that the engine-rooms and stokeholds be free of gas as early as possible. When tests show these places safe for entrance, the engineer officer enters to operate the electric forced draft system. After at least 3 hours of ventilation, operations are continued in the lower decks, proceeding systematically deck by deck. Sections difficult to ventilate may be aired by portable electric fans.

When the medical officer considers the ship safe for a final inspection he accompanies the contractor and the damage-control officer throughout the ship to test for traces of the gas. The fumigation flag, however, shall not be hauled down, and danger notices shall remain until the ship is formally turned over to the officer on watch. No section fumigated or in the danger area may be slept in until 12 hours have elapsed following the safety tests.

A good gas mask protects completely against hydrocyanic acid gas in the inspired air. However, the skin, particularly if wet as from perspiration, absorbs the gas with sufficient rapidity to produce signs of poisoning, a fact which should be remembered.

The penetration of the gas through clothing is practically immediate. A person may go into a relatively low concentration of the gas, 2 to 3 ounces per 1,000 cubic feet, without noting any skin effect; but concentrations of 6 to 10 ounces per 1,000 cubic feet, will at once produce a sensation of warmth over the entire body, becoming progressively pronounced. After 5 minutes in such an atmosphere the entire skin surface becomes noticeably reddened, and sensitive persons may experience an actual burning sensation. If this warning is disregarded, a feeling of weakness appears, followed by nausea and vomiting and not infrequently by headache. A still more advanced sign of poisoning is difficulty in breathing. This is the last warning, the forerunner of loss of consciousness and paralysis of the respiratory nerve center. Experienced fumigators seldom reach this stage. It is not unusual, however, to see them emerge from a large building decidedly unsteady and distressingly sick.

While there is not available at present any exact data regarding quantity absorption of the gas through the skin, it is believed that, protected with a good gas mask, one may remain in air containing 2 ounces HCN per 1,000 cubic feet for 20 minutes without experienc-

ing signs of poisoning. In a concentration of 4 ounces per 1,000 cubic feet, this should be reduced to 10 minutes, and in 8 ounces per 1,000 cubic feet to 5 minutes.

The distribution of 8 ounces of HCN per 1,000 cubic feet in a ship does not infer that fumigators are exposed to such high concentrations, since the full amount will not have entered the air under 1 hour's time. Moreover by withdrawing from the gas as it is deposited it is unlikely that the fumigators are actually exposed for the greater part of the time to more than 1 or 2 ounces per 1,000 cubic feet.

Fumigants generally are retained in bedding, mattresses, and over-stuffed furniture longer than in the other contents of the sections fumigated. It is therefore absolutely essential that all bedding, including blankets, pillows, hammocks, etc., are removed to the open air and hung out to air. Members of the crew should be instructed to beat their bedding thoroughly before airing.

It is also very important that no bedding, clothing, bags, or other possibly infested items be removed from the ship before fumigation, when the fumigation is for the purpose of eliminating insect pests. Care should also be taken that men are not housed in infested barracks during the time that the ship is fumigated. Moreover the men should be warned to inspect carefully the clothing worn when they leave the ship in order that no infestation will be carried back after the fumigation.

In cold weather the ship must be maintained at a minimum temperature of 70° F. in order to secure good results from fumigation. This is especially true of fumigation for the extermination of insect pests. Fumigation for the extermination of rats can be carried on at relatively lower temperatures. It is sometimes necessary to supply steam from a portable steam boiler on the dock in order to maintain such temperatures.

HCN gas at ordinary atmospheric pressure freezes at 8° F. and boils at 79° F. and when such temperatures occur, evaporation without an appropriate intermediate liquid state occurs. Thus it is quite possible that bedding might contain a lethal content of HCN and upon being removed to the cold air, the HCN freezes or changes to a liquid state with consequent slow evaporation, and with retention of the gas in the bedding, even though the bedding is aired for the required 8 to 12 hours. When the bedding is returned to the warm hold of the ship the HCN would again become gaseous and slowly give off a lethal concentrate with consequent danger to the sleeper.

Fumigations involving the lower dosages of gas required for the extermination of rats will lower the necessary period of aeration of the ship. However, safety tests should be made in exactly the same

manner as outlined above. Holds should clear of HCN in from 3 to 5 hours after a dosage of 2 ounces per 1,000 cubic feet.

Accidental poisoning by HCN gas requires prompt action:

1. Remove the patient as quickly as possible to gas-free, warm, comfortable surroundings.

2. Do not rush the unconscious man to a hospital. Prompt action on the spot is necessary.

3. If he is breathing, keep him in fresh air, but do not permit him to exert himself. Have him inhale from a bottle of ammonium carbonate.

4. Give aromatic spirits of ammonia in a small amount of water.

5. Give artificial respiration if indicated.

6. If available administer an oxygen-carbon dioxide mixture by inhalation.

7. Give sodium thiosulfate intravenously.

8. Do not breathe the gas yourself even for a short time. If it does not overcome you, it will at least cut down your strength. Protect yourself. In rescue work wear a gas mask on entering a place exposed to gas fumes.

CARBON TETRACHLORIDE POISONING

SHELTON P. SANFORD

Lieutenant Commander (MC) U. S. N. R.

Recently a case of sudden death from the industrial use of carbon tetrachloride was reported from the San Juan area.

The significant facts about this case were as follows:

A young seaman apparently in vigorous health ate a normal supper, took a shower bath, and was seen by others in the barracks to stagger toward his bunk. He collapsed and in spite of artificial respiration and all restorative measures was dead in a few minutes.

A complete autopsy was performed. The only positive findings were some congestion of the lung bases. (They did not collapse completely when the thorax was opened.) There were petechial hemorrhages over the epicardium. The brain stem was markedly congested but there was no extravasation of blood.

Microscopic examination of the tissues yielded no additional significant facts.

An hour-to-hour investigation of the man's activities during the day revealed that he had been working on and cleaning Diesel engine parts. His hands and forearms had become covered with grime. At about 1630, he used a bottle of carbon tetrachloride to remove the oil

and dirt from his hands and forearms, and also cleaned his shoes with the fluid. This was done over a barrel which contained waste water. The bottle of carbon tetrachloride was being used to clean engine parts and had been sitting on the workbench all day. A thorough investigation revealed no other clue to his sudden death.

This case suggests a review of the dangers of the industrial use of carbon tetrachloride.

Although great quantities of carbon tetrachloride are used in industry, amazingly few cases of fatal poisoning have been reported.

The chemical is used in many cleaning fluids under a great variety of names. The dry-cleaning industry uses great quantities of it. It is used in certain types of fire extinguishers. Most of the fatal cases are caused by inhaling the fumes or drinking the chemical. It is not known whether there is sufficient absorption through the unbroken skin to cause poisoning. Some positive research on this point is needed.

Most workmen who use this solvent are too tolerant of it. They ignore warnings of its toxic effects; it is true that many persons have used it over long periods of time with no apparent ill effects.

It was formerly used in medicine as a vermifuge, especially in the treatment of hookworm disease. It was very efficient in removing the parasites, but a death rate of eight per million was observed from therapeutic doses. It is now being replaced by tetra-ethylene which is relatively nontoxic in therapeutic doses.

The chemical is closely related to chloroform, chloral hydrate, and carbonyl chloride (phosgene).

Poisoning may fall into one of the following types:

1. Immediate fatal spasm of the laryngeal muscles.
2. Death within a few hours (phosgene?).
3. Death in a few days from hepatico-renal syndrome. This is what is known as late chloroform poisoning. It was formerly not infrequent following chloroform anesthesia, or following the intemperate use of chloral hydrate.
4. Extensive liver and renal damage from which there is prolonged convalescence but recovery is the rule.

Fatal results have followed the use of carbon tetrachloride as a shampoo. The drug is rendered much more toxic by the presence of traces of carbon disulfide, a common contaminant of the commercial product. Its use as a fire extinguishing agent has been fatal. In this case, it is supposed to be converted to phosgene, COCl_2 .

Persons who have used alcohol or who have calcium deficiency are more susceptible.

The postmortem findings in fatal cases have been as follows:

1. Immediate—no significant findings.
2. Death after several hours—moderate pulmonary congestion and petechial hemorrhage over epicardium.

3. Death after 24 hours or several days—focal necrosis of liver and nephritis,—especially degeneration of the tubular epithelium.

4. Death after several days or weeks—jaundice, etc.; recovery is the rule.

In the reported case, the time interval and necropsy findings are strikingly reminiscent of phosgene poisoning. It seems possible that the finely divided metal and grime removed from hands may have changed CCl_4 to COCl_2 , and that this was in fact a case of phosgene poisoning.

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COMPLETE VENEREAL PROPHYLAXIS WITH A SULFA-MERCURY COMPOUND¹

K. P. A. TAYLOR

Lieutenant Commander (MC) U. S. N. R.

During the twentieth century, few fields of investigation have been as neglected as that of chemical antivenereal prophylaxis. There has been, in effect, little extension of knowledge of the relative value of sundry antiseptics (and combinations of antiseptics) in preventing venereal contagion. The calomel ointment of Metchnikoff, for example, after a half century of use, remains virtually unchallenged as the premier antiluetic application. Few significant attempts at improvement or modification can be noted.

The painstaking and productive investigations of Rear Admiral H. W. Smith, (MC), U. S. N., retired, constitute the outstanding exceptions to the general lack of progress in this neglected field. Smith's objective has not been a simple one. He seeks (1) an all-purpose antiseptic (or combination of antiseptics) in suitable container, stable in composition, adaptable to a simple technic of application, nontoxic, nonirritating and noninjurious, colorless, stainless, relatively inodorous, inexpensive, and capable of effective action if applied before exposure. It should also protect against infection without prior soap-and-water cleansing. I am confident that this objective will be

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achieved. Smith modestly writes: "There are involved many considerations upon which there is no agreement, often no basic information. The whole subject is under discussion by the National Research Council."

DEVELOPMENT OF A MULTIVALENT COMPOUND

Interest in this problem was derived from the successful use of solutions of oxycyanide of mercury as an all purpose, antivenereal prophylactic. The clinical study was begun in 1932, and has been limited to the American drug, which contains approximately two times as much mercuric oxide as the British product of the same name. It is believed that the higher content of oxide radical gives the American compound greater bactericidal activity; yet it is less irritating than the preparation containing the higher mercuric cyanide fraction. I have never seen evidence of toxic absorption or of serious irritation following the external application and intra-urethral injection of 1:1000 aqueous solution of oxycyanide of mercury; nor have I noted instability or increase in irritating property of the American drug in solutions of this strength, 3 or more months old. (It may be desirable to fix an age limit on the use of preparations of this drug, but I have not been able to determine that this is the case). Under ordinary conditions of storage in opaque or dark-glass containers, the compounds to be described may acquire a gray or yellowish discoloration, but there is no evidence of deterioration in drug action.

The use of oxycyanide of mercury for venereal prophylaxis is, of course, quite well established. In Java the earlier investigations of Neisser did not confirm Metchnikoff's selection of calomel ointment, but pointed to the superiority of the mercuric solutions as antiluetic agents. Smith writes that an International Assembly in 1928 endorsed by resolution the use of oxycyanide of mercury in 1:1000 dilution as the superior of calomel ointment for the prophylaxis of syphilis.

Mahoney's (2) important researches on the etiology and prophylaxis of rabbit syphilis showed that local disinfection with ether, tincture of iodine, and alcohol (in sequence) prevented the development of rabbit syphilis if applied within 2 hours of constant, contact exposure; that it provided incomplete protection between the second and third hours, and was usually not effective after 3 hours. Mechanical cleansing with soap and water produced high protection up to 1½ hours, less protection after 2 hours and rapidly diminishing protection after 3 hours. There was only moderate superiority of the ether-iodine-alcohol prophylaxis over soap-and-water cleansing. In a third observation, calomel ointment was applied locally 1 hour after exposure; in this group, one animal contracted asymptomatic,

serum-positive syphilis. Mahoney also established that calomel ointment applied to a distant site 2 or 3 hours postexposure afforded full protection. He concluded that much of the prophylactic action of the ointment was systemic.

Though this concept has been vigorously opposed, Mahoney's work clearly indicated the feasibility of systemic prophylaxis against syphilis. (Ironically enough, popular attention is now fixed upon the systemic prophylaxis of gonorrhea and chancroid, while the more important infection, syphilis, is disregarded.) Mahoney and Bryant (3) consider that a postexposure interval exceeding 1 hour is too great to permit accurate evaluation of *any* local, surface prophylactic. The penetrative activity of the *Spirocheta pallidum* is such that *any* local agent may fail to protect if used after the 2-hour period. Mahoney writes: "Not any improvement has been effected in military prophylaxis since 1918" (5).

UNITARY COMPOUNDS

Smith's formula (6) of 1938 was: Mercuric cyanide 0.125, colloidal calomel 33.0, base 67.0 (the base formula: Cholesterol 2.0, petrolatum 98.0). Mercuric cyanide has since been substituted by oxyquinolin sulfonate, and the base altered. The Navy prophylactic tube contains camphor 2 percent, tricresol or thymol 2 percent, and phenol 3 percent in 33 percent calomel ointment. This formula is not effective against gonorrhea, and apparently does not often protect against chancroid. Gordon (7) reports that the Army has tried and rejected 3 percent phenol in calomel ointment; hexylresorcinol in place of protargol; and a soap-glycerine emulsion. Limited approval has been extended to 0.25 percent silver-picrate jelly to replace protargol. It is notable that the United States Coast Guard has relied upon a simple and effective unitary preparation—1 percent mercuric iodide soap. (Reports upon it are lacking.)

The writer has used, in private practice, an aqueous solution of oxycyanide of mercury as a unitary prophylactic since 1932. The necessity of its use within the 2-hour period has always been stressed, and the prescription has been entrusted only to intelligent, reliable individuals who could be depended upon to follow instructions. (This conforms with Mahoney's criteria for clinical evaluation of a prophylactic agent.) Soap and water washing was followed by washing with the oxycyanide solution; then by its injection and retention in the urethra for 5 minutes. Two hundred twenty-three prophylactics were given or prescribed with this solution. Its only disadvantage was the frequently expressed incredulity that *one* agent could be effective against more than one venereal disease. For this reason, sulfanilamide crystals were added to the oxycyanide solution in 1938,

in 5 percent dilution; 202 prophylactics were taken with this suspension. In 1942, an emulsion was prepared which could be placed in individual tubes or kits:

	Gm.
Mercuric oxycyanide.....	0.1
Sulfathiazole	5.00
Starch (corn).....	5.00
Distilled water to.....	100.0

In their comparison of bases for local drug application, Pillsbury et al. (8) have indicated that solutions promote the most effective drug action, with emulsions 90 percent as effective as solutions, while grease or ointment bases reduce drug activity by 50 percent. The formula presented here exhibits mercury in its most effective (soluble) form, and a sulfonamide in its most active local preparation—an emulsion. The mixture is white, of a smooth, creamy consistency. It undergoes no sensible alteration except a slight color change over a period exceeding 3 months. Application of the emulsion is not disagreeable. It does not leak from the compressed urethra as readily as does protargol, and there is scarcely an appreciable irritation after 5 minutes retention. Sulfanilamide crystals may be substituted for sulfathiazole—they are not as “smooth” in emulsion. Probably the best preparation is made with sulfathiazole tablets which contain stearic acid, starch and talc.

An equally effective emulsion can be prepared with starch paste. It is not as stable as the tragacanth emulsion, and can ordinarily be used for only a few weeks before separation occurs. It tends to adhere to the urethra even more closely than the tragacanth emulsion:

	Gm.
Mercuric oxycyanide.....	0.01
Sulfathiazole	5.00
Starch (corn).....	5.01
Distilled water to.....	100.00

The starch paste is first prepared, and the ingredients then added. (Differences in the quality, etc., and source of starch may require a larger or smaller proportion).

In use, the emulsions are first applied liberally to the genitals, which are not dried. The urethral injection is then made, and retained for 5 minutes. Any excess of emulsion is allowed to remain where applied, since it does not discolor the clothing. Wrapping is unnecessary.

CLINICAL ASSAY OF SULFA-MERCURY COMPOUND

Trial of the sulfa-mercury compound with tragacanth was carried out at an advanced base in the South Pacific area. Conditions could not have been more favorable for the evaluation of a prophylactic agent within the accepted time limit of 2 hours. (Had conditions not

been unusual in this respect, one would not have been justified in experimentation of this type.) The factors were these: Exposure of the crew occurred exclusively with professional prostitutes, who were under nominal police power of the United States Army and the local native government. Weekly examinations were made of all prostitutes. At the outset of this clinical test of a sulfa-mercury compound, the incidence of gonorrhea among them was 75 percent and syphilis 65 percent. Two months later, when the tests were half completed, the gonorrheal rate was still 65 percent and the syphilis rate 50 percent, despite a well-directed attempt to segregate and treat the infected prostitutes. The infection percentages are in themselves unusual, since repeated examinations were made of all prostitutes in the district. The high gonorrhea rate was without benefit of culture diagnosis. The presence of a relatively small and stable Navy crew (subjected to few changes in personnel and of excellent morale and high intelligence) also facilitated the assay. Most important, a sympathetic commanding officer had constructed at the entry gate of the naval base a prophylactic station in which the men could take, one might say, pride of a sort by its comparison with analogous equipment. This prophylactic station had, for example, the only hot showers then available at the base. The effect of these advantages was that very few of the crew failed to take prophylaxis after exposure; and the prophylaxis was usually administered within a 2-hour period.

The prophylactic station had three treatment booths. In one of them the sulfa-mercury compound (tragacanth) was placed, with instructions. In the other booths, 2 percent protargol and 33 percent calomel ointment were displayed. As evidence increased that the sulfa-mercury emulsion excelled the standard prophylactic agents, it was finally introduced into a second booth.

The test was conducted over a period of $3\frac{1}{2}$ months. Two hundred and eighty-seven prophylactics were given with protargol and calomel ointment; of these, seven failed to protect. In this group there were two cases of gonorrhea (one resulted from an incomplete prophylaxis); two "nonspecific" urethritis cases (because of technical staining difficulties it is believed that these cases were gonorrhea); and two chancroid infections—one following calomel ointment, the other the Navy-type "sanitube." Six weeks before the end of the study, two percent aqueous protargol was discarded for the standard prophylactic of a sterner era—3 percent protargol in 15 percent glycerin. This solution afforded complete protection against gonorrhea. Since it causes some irritation and burning, soldiers and sailors of today frequently object to its use. (Many have been told—by fifth columnists?—that it will produce impotence).

The present writer wishes to emphasize what was known to those medical officers who, in another emergency, and without restricting civilian populations, practically eliminated venereal disease in strategic areas in France: That 3 percent protargol in 15 percent glycerin will prevent gonorrhea; that 1 percent or 2 percent protargol, or argyrol weaker than 20 percent will frequently not prevent gonorrhea, even when used within the 2-hour period. (If a prophylactic agent yields over 2 percent infections in contacts, it is not a true prophylactic.)

RESULTS WITH MERCURIC OXYCYANIDE SOLUTION AND SULFA-MERCURY EMULSIONS

Used in the controlled manner outlined above, one would be surprised if infection ever followed 5-minutes' exposure to a 1:1000 solution of mercuric oxycyanide. Following the total of 752 prophylactic treatments with the solution and emulsions, no venereal infections are known to have developed (syphilis, gonorrhea, chancroid, or lymphogranuloma venereum). Three hundred and twenty-seven Navy prophylactics were administered with the sulfa-mercury compound during the period in which 287 "old type" prophylactics were taken. In this group of 327, a single case of 1-day urethral discharge occurred; this was free of organisms and was initiated by a chronic prostatic infection. No other infections developed, and no toxic reactions or unusual local irritation were noted. (Infections *have* occurred when the prophylactics were used 3 or more hours after exposure—such treatments are not considered prophylactic; they are not dealt with in this report.)

ADVANTAGES OF SULFA-MERCURY EMULSIONS

Failure to protect against chancroid is, in itself, an indictment of the protargol-calomel ointment prophylaxis. On many foreign stations chancroid ranks in incidence with, or above, gonorrhea. In others, lymphogranuloma venereum may exceed chancroid in prevalence. It is believed that sulfathiazole-oxycyanide emulsion, used within the 2-hour period, affords virtually complete protection against all venereal infections, as well as staphylococcic urethritis. (Except for its inefficacy against chancroid, and possibly lymphogranuloma, I believe that 3 percent protargol in 15 percent glycerine, and calomel ointment, constitute an equally effective prophylactic.)

Additional advantages of the emulsions are lack of irritation and staining, adherence to the urethra, adaptability to packaging multi-valency, and availability of ingredients. Until recently, all ingredients were on Army and Navy supply lists. Mercuric chloride in

1:5000 dilution can be substituted for the oxycyanide solution. It should be retained in the urethra only until irritation is first felt—usually about 20 seconds. It is not recommended for general use, but it is a satisfactory rapid prophylactic under direct supervision.

I have no doubt that unitary prophylactics having many advantages over these preparations will be developed. The prophylactic "ideal," envisioned by Stokes (9) (with the venereologist's unremitting raffishness) of a prior-application, pre-week-end "prevent-all", is (perhaps fortunately) not yet met. The emulsions described are suitable for prior immediate external application. (The relationship of lubrication to infection is too moot to consider here). These emulsions are promptly spermaticidal on contact and they cause no vaginal irritation. If preexposure application is made, intra-urethral treatment should be carried out postexposure, and external application should then be repeated.

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SULFAGUANIDINE AND SUCCINYLSULFATHIAZOLE FOR
BACILLARY DYSENTERY

During the past year there have been numerous reports on sulfaguanidine and a smaller number on succinylsulfathiazole in the treatment of bacillary dysentery, both in the active state and in carriers. From the evidence, so far as it is as yet available, sulfaguanidine is a specific drug for bacillary dysentery. Succinylsulfathiazole appears to be practically as effective and nontoxic as sulfaguanidine and, if further investigation bears out preliminary observations, may be proved somewhat superior.—Editorial: Sulfaguanidine and succinylsulfathiazole for bacillary dysentery. *J. A. M. A.* 121: 1353, Apr. 24, 1943.

STATISTICS

HEALTH OF THE NAVY

The statistics (annual rates per 1,000) appearing in this summary were compiled from data contained in monthly reports of communicable diseases reviewed in the Bureau for the months of January, February, March, 1943.

ENTIRE NAVY

Year	All diseases	Injuries and poisonings	All causes	Communicable diseases		Venereal diseases
				A	B	
1938.....	387	46	434	9	128	86
1939.....	423	47	470	19	168	80
1940.....	499	49	548	21	206	90
1941.....	591	45	636	87	254	62
1942.....	519	47	566	67	223	41
1943.....	536	41	577	78	243	28

FORCES ASHORE

1938.....	447	50	497	14	195	40
1939.....	487	47	534	10	253	41
1940.....	583	43	626	26	300	49
1941.....	759	46	805	140	370	42
1942.....	569	46	615	83	251	26
1943.....	580	39	619	92	278	21

FORCES AFLOAT

1938.....	353	44	397	6	90	113
1939.....	390	47	437	24	125	100
1940.....	439	54	493	17	139	119
1941.....	458	44	502	46	163	78
1942.....	431	48	478	39	175	67
1943.....	375	49	425	24	119	54

Septic sore throat.—A sudden outbreak of septic sore throat occurred at the United States Naval Training School (W. R.), the Bronx, New York, N. Y., on March 26, 1943. During the first 24 hours 74 cases occurred explosively and caused immediate concern regard-

ing the potential health hazard to the entire personnel. To determine the cause of the outbreak, the following measures were instituted:

1. Bacteriological studies of throat cultures by the Rockefeller Institute staff.

(a) On March 26, 1943, throat cultures were obtained from nine typical selected cases, which had not received any therapy. Clinical evidence suggested hemolytic streptococci were probably responsible for the acute tonsillitis and acute pharyngitis in these cases.

(b) On March 27, 1943, throat cultures were obtained from 62 persons on mess detail.

2. Bacteriological studies of water from the swimming pool by the New York City Health Department, determination of chlorine content and pH by the station's staff, and a special experimental study by the Rockefeller Hospital staff in which a patient with a septic sore throat gargled with water (chlorine content 0.5 parts per 1,000,000) from the swimming pool and culture of the gargle was obtained.

3. Smears of throat exudate by station laboratory.

4. Repeated inspection of throats of mess and galley crew, and the administration of prophylactic sulfadiazine (1 gram per day) for 7 days even though throat cultures failed to reveal the presence of group A hemolytic streptococci.

As a result of these investigative measures by the staff of the Rockefeller Institute, it was determined that of nine cultures obtained on March 26, 1943, alpha hemolytic streptococci were found in seven cases. These were of the untypable variety.

The entire company of the mess and galley, both sick and well, were cultured on the second day. Two well seamen were found with positive alpha hemolytic streptococci, one type 6, the other type 28. Three seamen treated in the sickbay for septic sore throats, were found with positive alpha hemolytic streptococci; one did not type, one had a type 6, and one had a questionable type 11. Twenty-three out of a total 110 cases were members of the mess and galley crew.

The results of the cultures obtained from swimming pool water (free chlorine content 0.5 parts per 1,000,000) are tabulated below, chronologically with respect to the time which elapsed between gargling with the water and the inoculation of media:

Immediate-----	Positive.
2 hours-----	Positive.
10 hours-----	Positive.

In each culture there were progressively fewer streptococci grown. To control the outbreak the following measures were taken:

(a) An entire barracks was taken over by the Medical Department for isolation and treatment of these cases.

(b) Through the district medical officer, three extra nurses were procured from United States Naval Hospital, Brooklyn, for temporary duty, and worked with three nurses of this activity on 8-hour watches. Female hospital corpsmen aided the nurses.

(c) Essential mess gear was stored in the building and was sterilized by boiling after each meal, new G. I. cans were employed for this purpose.

(d) The swimming pool was closed.

(e) Uncooked vegetables and salads were eliminated from the menu until all carriers of group A hemolytic streptococci had been withdrawn from the mess detail.

A composite of the clinical picture ran thus: Within 6 to 12 hours before admission, the patient complained of severe sore throat or of difficulty in swallowing, headache, chills, and fever. The average temperature was 102.2° F. The patients were flushed. Examination revealed either greatly hypertrophied, injected tonsils or large patches of pharyngeal lymphoid tissue (in patients without tonsils), speckled by purulent exudate. Enlarged tender anterior cervical lymph glands were generally present. Those patients without tonsils, in general, had a milder course. In two cases, a mild catarrhal otitis media occurred but these quickly resolved under sulfadiazine. A breakdown of the admissions disclosed 74 cases on the first day, 16 on the second, 7 on the third, 5 on the fourth, 6 on the fifth, 2 on the sixth and 0 on the seventh—a total of 110 cases. Barracks I was evacuated by the Medical Department on April 3, 1943. During the first 2 weeks of April, 7 recurrences were reported.

The following routine treatment was adopted:

1. Sulfadiazine 1 gram every 4 hours for six doses, if the patient was clinically improved, the dosage was cut to $\frac{1}{2}$ gram every 4 hours and continued for at least 48 hours. No patient received a total dosage of more than 30 grams.
2. The throats were swabbed with tincture of merthiolate three times daily.
3. Fluids were forced.

Inasmuch as the positive cultures were of different strains, typable and untypable alpha hemolytic streptococci, it is felt that no conclusions can be made at this time as to the source of the epidemic.

DISEASES CAUSING SURVEY

The following table was prepared from reports of medical surveys received in the Bureau during March and April 1943, in which disabilities or disease causing the survey were noted existing prior to entry into the Navy. With certain diseases, survey followed entry so rapidly that it would seem that many might have been eliminated in the recruiting office:

Cause of survey	Num- ber of surveys	Cause of survey	Num- ber of surveys
Abscess, periapical	9	Bladder, neurogenic	1
Abscess, sterile, bone	1	Blepharitis	1
Absence, acquired, kidney	1	Blindness	1
Absence, acquired, teeth	41	Boeck's sarcoid	1
Absence, congenital, second sacral posterior arch	1	Bronchiectasis	25
Absence, congenital, spinous process, vertebra	1	Bronchitis, chronic	16
Accessory ribs	1	Bursitis, chronic	5
Acne vulgaris	3	Calculus, kidney	5
Acromegalia	1	Calculus, renal	6
Actinomycosis	1	Calculus, salivary gland	1
Addison's disease	1	Carcinoma, stomach	1
Adherent retroversion, uterus	1	Carcinoma, transitional cell epidermoid	1
Adhesions, abdominal	3	Cardiac arrhythmia, heart block	3
Adhesions, intestinal and com- mon duct	1	Cardiac arrhythmia, paroxys- mal tachycardia	10
Adhesions, pelvic	1	Cardiac arrhythmia, prema- ture contractions	1
Adhesions, peritoneal	1	Cardiac disorder, functional	2
Airsickness	1	Cardiospasm	1
Albuminuria	36	Caries, teeth	28
Alcoholism, chronic	23	Cataract	10
Allergy, multiple	1	Cataract, congenital	4
Allergy, nasal	3	Cataract, traumatic	1
Allergy, skin	1	Cerebral arteriosclerosis	1
Amblyopia	76	Cerebral syndrome, post-trau- matic	2
Amblyopia ex anopsia	1	Cerebrospinal syphilis, undif- ferentiated	5
Amputation, traumatic	6	Cholecystitis, chronic	10
Anemia, pernicious	2	Cholelithiasis	3
Anemia, secondary	1	Chorea, chronic	1
Anemia, sickle cell	1	Chorioretinitis	12
Aneurysm, pulmonary artery	1	Choroiditis	4
Aneurysm, traumatic, left axil- lary artery	2	Cicatrix, meningocerebral	1
Angina pectoris	5	Cicatrix, skin	11
Angioneurotic edema	1	Colitis, chronic	1
Ankylosis	7	Colitis, ulcerative	10
Anomaly, congenital diaphragm	2	Coloboma of iris	1
Arteriosclerosis, cerebral	1	Color blindness	2
Arteriosclerosis, general	5	Concussion syndrome, post- traumatic	2
Arteriosclerosis, local	1	Conjunctivitis	1
Arthritis, chronic	206	Constitutional asthenia	1
Arthritis deformans	5	Constitutional psychopathic inferiority with psychosis	1
Asthma	153	Constitutional psychopathic inferiority without psychosis	122
Astigmatism, compound hyper- opic	8	Constitutional psychopathic state, criminalism	2
Astigmatism, compound myo- pic	8	Constitutional psychopathic state, emotional instability	337
Astigmatism, mixed	8	Constitutional psychopathic state, inadequate personality	295
Astigmatism, simple myopic	1	Constitutional psychopathic state, paranoid personality	18
Atelectasis	1	Constitutional psychopathic state, pathological liar	1
Atrophy, anterior tibial mus- cles	1	Constitutional psychopathic state, schizoid personality	24
Atrophy, right forearm and hand	1		
Atrophy, left optic nerve	2		
Atrophy, cerebral	1		
Atrophy, left arm	1		
Atrophy, leg	4		
Atrophy, right shoulder girdle	1		
Atrophy, right testicle	1		

Cause of survey	Num-ber of surveys	Cause of survey	Num-ber of surveys
Constitutional psychopathic state, sexual psychopathy	22	Endocrinopathy, pituitary obesity	1
Contracture	5	Enlargement, prostate	2
Convulsive seizures	1	Enteritis, chronic	1
Coronary heart disease, arteriosclerotic	15	Enuresis	75
Coxa valga	1	Epididymitis, chronic non-venereal	3
Coxa vara	3	Epilepsy	181
Cryptorchidism	11	Epilepsy, Jacksonian	4
Curvature, spine	9	Epiphora	1
Cyst, benign, left tibia	1	Epiphysitis, head of right femur	1
Cyst, benign, right os calcis	1	Epiphysitis, dorsal spine	3
Cyst, ovarian	8	Epiphysitis, right elbow	1
Cyst, lung	3	Epithelioma	1
Cyst, parencephalic	1	Erythema multiforme	1
Cyst, teratoma, inflamed	1	Fistula in ano	3
Cyst, thyroglossal	1	Fistula, thyroglossal	1
Dacryocystitis	3	Fistula, urethral	1
Deafness, bilateral	70	Flat foot	241
Deafness, unilateral	25	Foreign body, traumatic	6
Defective physical development	4	Fracture, compound	2
Deformity, acquired	137	Fracture, simple	29
Deformity, congenital	86	Fungus infection, skin	2
Dementia paralytica	4	Gastritis, chronic	27
Dementia praecox	193	Gastroenteritis, chronic	2
Dementia pugilistica	1	Gastroptosis	2
Depression, recurrent	2	Genu valgum	2
Dermatitis, acute	1	Glioma, cerebellum (recurrent)	1
Dermatitis, allergic	2	Glycosuria	1
Dermatitis, atopic	6	Gonococcus infection, cervix	1
Dermatitis venenata	1	Gonococcus infection, joint	1
Dermatitis herpetiformis	1	Gonococcus infection, prostate	2
Dermatitis, intertrigo	1	Gonococcus infection, urethra	1
Dislocation, articular cartilage	16	Gout, chronic	1
Dislocation, chronic recurrent	32	Hallux valgus	3
Dislocation, head of radius	1	Hammertoe	3
Dislocation, larynx	1	Hay fever	3
Dislocation, patella	1	Headache	19
Dislocation, first cervical vertebra	1	Heart disease, congenital	18
Dislocation, fifth lumbar vertebra	4	Hemangioma	2
Diverticulum, duodenum	1	Hematoma, traumatic, left hip	1
Diverticulum, esophagus	1	Hematoma, subdural, traumatic	3
Diverticulosis, intestinal	1	Hematuria	5
Duodenitis	1	Hemianopsia	1
Dysinsulinism	4	Hemiplegia, old	2
Dystrophy, progressive	2	Hemophilia	3
Ectopic kidneys, congenital	1	Hemorrhoids	4
Eczema	14	Hernia, epigastric	2
Effort syndrome	19	Hernia, inguinal, indirect	49
Emphysema, pulmonary	2	Hernia, recurrent after operation	6
Encephalitis, chronic	6	Hernia, lumbar	1
Encephalomyelitis, chronic, degenerative	1	Hernia, umbilical	3
Encephalopathy, post-traumatic	1	Hernia, ventral	3
Encephalopathy, traumatic	2	Hernia, traumatic	2
Endarteritis, legs	4	Hernia, femoral	1
Endocrinopathy, anterior pituitarism	1	Herniation, nucleus pulposus	2
		Histaminic cephalalgia	1
		Hodgkin's disease	2
		Hydrocele, tunica vaginalis	1

Cause of survey	Num-ber of surveys	Cause of survey	Num-ber of surveys
Hydrocephalus	1	Neuroretinitis	2
Hydronephrosis	7	Neurosis, gastric	9
Hyperchlorhydria	1	Neurosis, intestinal	7
Hyperinsulinism	1	Neurosyphilis, serological	5
Hyperopia	3	Nevus, trunk	1
Hypertension, arterial	92	Nostalgia	1
Hypertensive heart disease	13	Nystagmus	1
Hyperthyroidism	9	Obesity	1
Hypochlorhydria	1	Obstruction, intestinal	2
Hypochondriasis	4	Opacity, cornea	2
Hypotension, arterial	6	Opacity, vitreous humor	1
Hypothyroidism	1	Orchidalgia	1
Ichthyosis	6	Osgood-Schlatter disease	9
Incontinence, anal	1	Osteoarthropathy, hyper-trophic	4
Incontinence, urine	2	Osteochondritis deformans	10
Insomnia	1	Osteochondritis dissecans	6
Insufficiency, ocular muscle	5	Osteochondroma, clavicle	1
Intracranial injury, old	35	Osteochondroma, tibia	1
Iridocyclitis	1	Osteochondromatosis	2
Irritable colon	4	Osteoma	1
Jaundice, hemolytic	1	Osteomyelitis, chronic	14
Joint, internal derangement	68	Otitis media, chronic	139
Keratitis	1	Otosclerosis	2
Keratoderma	1	Ozena	1
Keloid	1	Pansinusitis	4
Keratosis	1	Paradentosis	4
Labyrinthitis	1	Paralysis agitans	1
Laryngitis, chronic	2	Paralysis, brachial plexus	2
Leukemia, chronic	1	Paralysis, nerve	8
Loss of substance of bone	2	Paralysis, ocular muscle	4
Lymphedema, left leg	1	Paramyoclonus multiplex	1
Lymphoma, mediastinal	1	Perforated ear drum	3
Macular degeneration	2	Periostitis, traumatic	2
Malformation of lumbar spine	1	Pes cavus	22
Malocclusion, teeth	2	Phlebitis	7
Mastoiditis, chronic	3	Pleurisy, fibrinous	12
Melanoma, left eye	1	Pleurisy, serofibrinous	2
Mental deficiency (moron)	62	Pneumonitis, chronic, nontu-berculous	10
Metatarsalgia	5	Pneumothorax	1
Migraine	31	Poliomyelitis, anterior, chronic	3
Myelitis, disseminated	1	Postencephalopathy tremor	1
Myocarditis, chronic	22	Postural defect	1
Myofascitis, chronic	6	Prespondylolisthesis, fifth lum-bar vertebra	1
Myopia	22	Prolapse, rectum	1
Myositis, chronic	112	Prostatitis, chronic, nonvene-real	9
Myotonia congenita	1	Protruded intervertebral disc	1
Narcolepsy	3	Pruritus ani	1
Nephritis, acute	1	Psoriasis	6
Nephritis, chronic	17	Psychoneurosis, anxiety neu-rosis	110
Neuralgia	5	Psychoneurosis, compulsion neurosis	7
Neuritis, brachial	1	Psychoneurosis, hysteria	91
Neuritis, dorsal	1	Psychoneurosis, mixed	12
Neuritis, external saphenous	1	Psychoneurosis, neurasthenia	80
Neuritis, femoral, left	1	Psychoneurosis, psychasthenia	10
Neuritis, multiple	5	Psychoneurosis, situational	18
Neuritis, musculocutaneous	1	Psychoneurosis, unclassified	101
Neuritis, optic	3		
Neuritis, sciatic	16		
Neuritis, traumatic	1		
Neuritis, ulnar	2		
Neurodermatitis	2		
Neurofibromatosis	1		

Cause of survey	Num-ber of surveys	Cause of survey	Num-ber of surveys
Psychoneurosis, traumatic.....	11	Symblepharon.....	1
Psychopathic personality.....	3	Syncope.....	12
Psychosis, epileptic.....	1	Synechia.....	2
Psychosis, intoxication, alco- holic.....	3	Synovitis, chronic.....	12
Psychosis, manic depressive.....	47	Syphilis.....	23
Psychosis, traumatic.....	1	Syphilis, seropositive only.....	4
Psychosis, unclassified.....	23	Tabes dorsalis.....	3
Psychosis, with other disabili- ties (mental deficiency).....	8	Tachycardia.....	5
Psychosis, with other disabili- ties (C. P. S., inadequate personality).....	1	Talipes.....	5
Ptosis, congenital.....	1	Thrombo-angiitis obliterans.....	4
Purpura hemorrhagica.....	1	Thrombosis, cerebral.....	2
Pyelitis, chronic.....	7	Thrombosis, coronary.....	1
Pyelonephritis.....	3	Thrombosis, left axillary vein.....	1
Pylorospasm.....	1	Thrombosis, left femoral vein.....	3
Radiculitis (lumbar).....	1	Torsion, traumatic, tarsal bones, right foot.....	1
Recklinghausen's disease.....	1	Trachoma.....	1
Retinitis.....	10	Tremor, congenital.....	1
Renal disease, polycystic, con- genital.....	2	Trench foot.....	1
Rheumatic fever.....	14	Tuberculosis, general miliary.....	1
Rheumatism, muscular.....	5	Tuberculosis, primary, healed.....	10
Rhinitis, atrophic.....	1	Tuberculosis, pulmonary, chronic, active advanced.....	45
Rupture, traumatic.....	15	Tuberculosis, pulmonary, chronic, arrested.....	138
Rupture, nontraumatic.....	1	Tuberculosis, testicle.....	1
Rupture, intervertebral disc.....	1	Tumor, mixed, benign.....	2
Scar, extensive, postoperative.....	1	Tumor, mixed, activity unknown.....	3
Sarcoma.....	1	Tumor, brain, type unknown.....	2
Scleritis.....	2	Ulcer, duodenum.....	257
Sclerosis, disseminated.....	1	Ulcer, duodenum, perforated.....	1
Sclerosis, lateral amyotrophic.....	1	Ulcer, stomach.....	15
Seasickness.....	11	Undulant fever.....	1
Senility.....	1	Union of fracture, faulty.....	51
Sexual perversion.....	5	Urticaria.....	10
Sexual underdevelopment.....	1	Valvular heart disease, aortic and mitral.....	41
Silicosis.....	2	Valvular heart disease, aortic insufficiency.....	26
Simple adult maladjustment.....	12	Valvular heart disease, aortic stenosis.....	2
Sinusitis, ethmoidal.....	2	Valvular heart disease, mitral insufficiency.....	78
Sinusitis, frontal.....	1	Valvular heart disease, mitral stenosis.....	62
Sinusitis, maxillary.....	16	Valvular heart disease, pul- monic.....	3
Snapping ankle.....	1	Varicocele.....	6
Somnambulism.....	10	Varicose veins.....	22
Spondylitis.....	9	Vertigo.....	2
Spondylolisthesis.....	10	War hysteria.....	1
Sprain, joint.....	14	Warts, plantar.....	1
Spur, bone.....	2	Xeroderma pigmentosa.....	2
Strabismus.....	12		
Stammering.....	3		
Strain, muscular.....	1		
Stricture, esophagus.....	1		
Stricture, intestine.....	1		
Stricture, rectum.....	1		
Stricture, ureter.....	2		
Stricture, urethra.....	4		
		Total.....	5, 645

CAUSATION OF TRANSFUSION REACTION

The diagnosis of a haemolytic reaction is based on evidence of increased blood destruction following transfusion and on the demonstration of a cause for this destruction. The commonest cause of severe haemolytic transfusion reactions at the present time are: (1) Mistakes in blood grouping; (2) the use of Rh-positive blood for transfusion to recipients sensitized to the Rh agglutinin; and (3) failure to maintain adequate standards in blood storage.

The investigation of haemolytic transfusion reactions is greatly facilitated if a sample of donor blood is kept available for investigation for at least 24 hours after the transfusion, and is further facilitated if a pretransfusion sample from the recipient is also kept available for testing. When the patient is seen within 12 or 24 hours of transfusion the increased destruction can often be demonstrated by simply obtaining a venous sample from him and showing that it contains oxyhaemoglobin, methaemalbumin, or an increased concentration of bilirubin.—Mollison, P. L.: The investigation of haemolytic transfusion reactions. *Brit. M. J.* 559-561, May 8, 1943.



MAGNESIUM SULFATE AS A HORMONE PRODUCER

Magnesium sulfate acts upon gall bladder and upon sphincter in the same way and for the same length of time as egg yolk. It differs only in degree, a characteristic which may be attributed to slower absorption rate or less effective chemical action. Accordingly, it is suggested that magnesium sulfate, like egg yolk, is to be considered as a hormone-producing substance which acts independently, through the blood stream, upon both the gall bladder and the sphincter of Oddi.—Boyden, E. A.; Bergh, G. S.; and Layne, J. A.: An analysis of the reaction of the human gall bladder and sphincter of Oddi to magnesium sulfate. *Surgery* 13: 723, 1943.



EXTREME HEAT AND SURGICAL SHOCK

Blalock and Mason found that in dogs suffering from shock induced by trauma or hemorrhage, the application of extreme heat (causing a rise in body temperature) diminished the chance of survival and shortened the period of survival, whereas, extreme cold (with a fall in body temperature) had no ill effect. These authors are of the opinion that drastic means to elevate the skin temperature of the patient in shock should not be used.—Nash, C. C.: *Surgical Physiology*. Charles C. Thomas, Springfield, Ill. Pp. 35-56.

NOTES ON OUR RESERVE CONTRIBUTORS

Atsatt, Rodney F., Commander (MC) USNR, retired (*A Simple Procedure for the Control of Fungus Infection of the Feet*, p. 1450). M. D., Medical School, University of California, 1924. Resident, Shriners' Hospital, San Francisco, 1924-25; house officer, Massachusetts General Hospital and Boston Children's Hospital, 1926-27; orthopedic surgeon, Santa Barbara Clinic, 1927-41. Fellow American Academy of Orthopedic Surgeons; member Western Academy of Orthopedic Surgeons; diplomate American Board of Orthopedic Surgery; fellow American College of Surgeons.

Bartlett, Willard, Jr., Lieutenant Commander (MC) USNR (*The Conversion of Liquid to Gaseous Oxygen for Therapy*, p. 1446). M. D., University of Michigan, 1926. Intern, 1926-27, assistant resident surgeon, 1927-28, University of Michigan Hospital, Ann Arbor. Private practice, surgery, with Willard Bartlett, Sr., St. Louis, Mo., 1928-. Certified 1937. Surgeon: Firmin Desloge; Jewish Hospital; St. Mary's Hospital; surg. staff, De Paul Hospital; visiting surgeon, City Sanitarium. Instructor, surgery, St. Louis University. Fellow American College of Surgeons; American Association for the Study of Goiter; American Medical Association; Association for the Study of Internal Secretions; Central Society for Clinical Research; Mississippi Valley Medical Society; Southern Medical Association; Western Surgical Association; American Board of Surgery (Founders' Group), 1937. Author, "General Considerations of Surgical Patients," in "The Cyclopedia of Medicine, Surgery and Specialties," published by F. A. Davis Co., 1939.

Bierman, Howard R., Lieutenant (MC) USNR (*A Suggested Method for Simultaneous Intubation and Oxygen Administration in Aerial Transportation*, p. 1417). B. S., medicine, and M. D., Washington University, 1939. Research assistant, Department of Medicine, Washington University, 1936-40; house officer, Barnes Hospital, St. Louis, Mo., 1939-41; resident physician, Isolation Hospital of City of St. Louis, 1940.

Brown, Herbert R., Jr., Lieutenant (MC) USNR (*Laboratory Aids in the Treatment of the Shock State*, p. 1345). A. B., Harvard University, 1934; M. D., University of Rochester School of Medicine and Dentistry, 1939. Intern, medicine, 1939-40; assistant resident, medicine, 1940-41; resident, fever therapy and neurology, 1941-42. Instructor in medicine (on leave) 1942, Strong Memorial and Rochester Municipal hospitals, University of Rochester. American Medical Association; American Federation of Clinical Investigation.

Bush, Frederick W., Lieutenant Commander (MC) USNR (*Contact Dermatitis from Black Cotton Socks*, p. 1408). M. D., Queen's University, Canada, 1922. Hotel Dieu Hospital, Kingston, Canada, 1922; St. Mary's Hospital for Children, New York, 1924-25. Certified American Board of Pediatrics, 1935. Attending, Convalescent Hospital for Children; Highland Hospital; Rochester General Hospital; instructor, pediatrics, Rochester University; assistant pediatrician, Strong Memorial Hospital. Member Academy of Pediatrics; American Medical Association.

Carleton, William T., Lieutenant (MC) USNR (*Mumps Encephalitis; Report of 3 Cases*, p. 1401). A. B., Williams College, 1935; M. D., Harvard Medical School, 1939. Worcester City Hospital 1939-41.

Carmody, John T. B., Lieutenant Commander (MC) USNR (*War Wounds of the Head*, p. 1227). A. B., Yale College, 1927; M. D., Yale University, 1932. Intern, general surgery, 1932-33, resident in orthopedic surgery, 1934-35. Lakeside Hospital, Cleveland, Ohio; house officer, neurosurgery, 1933-34, resident, neurosurgery, 1935-37, and assistant neurosurgeon, Massachusetts General Hospital, Boston; demonstrator, orthopedic surgery, Western Reserve University School of Medicine, 1934; neurosurgeon: Worcester Memorial Hospital, 1937, Worcester City Hospital, 1939; Worcester State Hospital, 1938. Fellow American College of Surgeons; American Medical Association; Massachusetts Medical Association.

Carr, Francis J., Jr., Commander (MC) USNR (*Extensive (60 Percent) Burn: Report of Case*, p. 1410). B. S., Hobart College, 1919; M. D., Loyola University School of Medicine, 1924. Intern, New York City Hospital, Welfare Island, 1924-26; resident, Hospital for Ruptured and Crippled, 1926-27. Certified 1937. Associate attending, Hospital for Special Surgery; attending orthopedic surgeon, New Rochelle Hospital, New Rochelle; director of orthopedic surgery, Hospital for Ruptured and Crippled. Consulting orthopedic surgeon: Neurological Institute, New York City; Ossining Hospital, Ossining; St. Francis Hospital, Poughkeepsie; director orthopedics, St. Agnes Hospital, White Plains; district orthopedic surgeon, New York State Department of Health. Fellow American College of Surgeons; member American Academy of Orthopedic Surgeons; American Medical Association; diplomate American Board of Orthopedic Surgery; American Academy of Orthopedic Surgeons.

Cashman, William M., Lieutenant Commander (MC) USNR (*Suicide Due to Promotion Depression; A Case Report*, p. 1412). M. D., Jefferson Medical College, 1928. Jefferson Hospital, 1928-31; attending surgeon, Warren (Pa.) General Hospital, 1935. Fellow American College of Surgeons; Member American Medical Association; Pennsylvania State Medical Society.

Coburn, Alvin F., Lieutenant Commander (MC) USNR (*The Management of Navy Personnel with Rheumatic Fever*, p. 1324). Phillips Andover, 1917; Yale, 1921; Johns Hopkins Medical School, 1925. Medical resident, Columbia, Presbyterian Medical Center, 1927-30; Proudfit fellow, Columbia University, Department of Medicine, 1930-34; assistant professor of medicine, Columbia University, 1934-42; visiting investigator, Rockefeller Institute, 1940-41; hospital attending, Presbyterian Hospital, Vanderbilt Clinic, Bellevue, Willard Parker, and St. Vincent's hospitals; consultant, Grasslands Hospital. Member Committee on Public Health Relations; New York Academy of Medicine; Harvey Society; American Heart Association; Society of Clinical Investigation; Society of American Physicians; American Association for Advancement of Science. Author, *The Factor of Infection in the Rheumatic State*, 1931.

Colonnell, William J., Lieutenant Commander (MC) USNR (*Allergic Reaction to Dried Human Plasma*, p. 1356). M. D., New York Medical College, 1929. Intern, Flushing Hospital; resident, St. Cecilia Hospital, New York City; private practice, Flushing, Long Island, N. Y., 1931-42; associate attending, obstetrics and gynecology, Flushing Hospital. Member Queens County Medical Society, New York State Medical Society.

- Donovan, Stephen J.**, Lieutenant Commander (MC) USNR (*Extensive (60 per cent) Burn; Report of Case*, p. 1410). M. D., University of Michigan Medical School, 1932. Intern, 1932-33, and assistant surgical resident, 1933-34, University of Michigan Hospital, Ann Arbor, Mich.; surgical resident, Children's Hospital, Detroit, 1934-35; surgical resident, Receiving Hospital, Detroit, 1935-36; medical director, Receiving Hospital, Detroit, July-November 1936; surgeon, Clinic Hospital, Michigan City, Indiana, 1937-39; private practice, Michigan City, Ind., 1939-May 1941. Member Indiana State Medical Association; American Medical Association; American College of Surgeons.
- Eichold, Samuel**, Lieutenant (MC) USNR (*Filariasis in Defense Force, Samoan Group; Preliminary Report*, p. 1240). B. S., 1938; M. D., 1940, Tulane University. Intern, Touro Infirmary, New Orleans, 1940-41.
- Engelfried, John J.**, Lieutenant Commander H-V(S) USNR (*Determination of Sulfonamides; A Modified Field Procedure*, p. 1439). A. B., B. S., M. S. P. H., D. P. H., University of Michigan. Instructor, Department of Pediatrics and Infectious Diseases, University of Michigan Medical School, 1934-41. Member Michigan Pediatrics Society; Michigan Academy of Science, Arts and Letters; American Association for the Advancement of Science; American Public Health Association.
- Flory, Clyde R.**, Commander (MC) USNR (*Thomas Splint Traction Bar*, p. 1428). B. A., Lehigh University, 1920; M. D., University of Michigan, 1926. Intern, Paterson General Hospital, Paterson, N. J., 1926-27; private practice, Sellersville, Pa.; member surgical staff, Grand View Hospital, Sellersville, Pa., 1928-; member Board of Directors, and member of the training school committee of Grand View Hospital; instructor of orthopedic surgery. Member American Medical Association; Pennsylvania State Medical Society; Bucks County Medical Society (past president).
- Goodale, Raymond H.**, Commander (MC) USNR (*A Sterilization Process for Powdered Sulfonamides*, p. 1360). B. S., Wesleyan University, 1920; M. D., Harvard University Medical School, 1924. Adjunct professor of pathology, American University, Beirut, Syria, 1926-29; associate pathologist, City Hospital, Worcester, Mass., 1929-31; pathologist since 1931; assistant professor experimental pathology, Boston University School of Medicine, 1935-. Author, Interpretation of Laboratory Findings, 1936. Member, American Medical Association; American Board of Pathology; American Association of Pathologists and Bacteriologists; New York Pathological Society.
- Hand, Eugene A.**, Lieutenant (MC) USNR (*The Treatment of Chronic Gonorrhea with Combined Sulfathiazole and Intravenous Typhoid Vaccine*, p. 1365). M. D., Michigan University, 1932; M. S. in dermatology and syphilology, 1936. Intern, University Hospital, Ann Arbor, 1933-36. Certified 1939. Associate staff, Mercy Hospital, Bay City; junior staff, St. Mary's Hospital. Member American Medical Association.
- Harris, Herbert I.**, Lieutenant Commander (MC) USNR (*Electroencephalography in the Selection of Naval Recruits*, p. 1310). B. S., Massachusetts State College, 1927; M. D., Tufts Medical School, 1936. Instructor, Tufts Medical School, 1939-41; assistant, neurology, Harvard Medical School, 1940-41; assistant, neurology, Tufts Medical School, 1939-41; editor, Bulletin New England Medical Center, 1939-41; psychiatrist, Norfolk State Prison Colony, 1940-41; assistant medical director, Joseph H. Pratt Diagnostical Hospital, 1939-41; consultant, neurology and psychiatry, St. John's Hospital, Lowell.

Mass. Member American Medical Association; Massachusetts Medical Society.

Hunt, William A., Lieutenant Commander H-V(S) USNR (*Electroencephalography in the Selection of Naval Recruits*, p. 1310; *Detection of Malingering Through Psychometric Tests*, p. 1318). A. B., Dartmouth College, 1928; A. M. Harvard, 1929; Ph. D., 1931. Professor, psychology, Wheaton College, 1930-33; Fellow American Association for Advancement of Science, member executive-committee sec. I; American Psychological Association, member committee on displaced foreign psychologists; Society Experimental Psychologists; American Association of Applied Psychology; American Psychopathological Association. Cooperating editor Psychological Bulletin.

Huntington, Robert W., Jr., Lieutenant Commander (MC) USNR (*Filaria in Defense Force, Samoan Group; Preliminary Report*, p. 1240). B. A., Yale College, 1928; M. D., Yale Medical School, 1933. Intern, Pediatric Service, New Haven Hospital, 1932-33, assistant resident, 1934-35; special work in clinical bacteriology, Dept. of Pediatrics, Yale University School of Medicine, 1933-34, under Powers fellowship grant; Theron Catlin fellow in infectious diseases, St. Louis Children's Hospital and Washington University, Dept. of Pediatrics, St. Louis, Mo.; assistant physician, St. Louis Children's Hospital, 1935-38; instructor in pediatrics, Washington University, 1937-38; research in tuberculosis under grant from International Health Division, the Rockefeller Foundation; instructor in pathology, Cornell University Medical College, 1938-41. Member Society of American Bacteriologists.

Jacobs, Raymond G., Lieutenant Commander (MC) USNR (*Observations on Pilonidal Cysts*, p. 1296). B. S., University of Iowa, 1926; M. D., College of Medicine, University of Iowa, 1928. Intern, St. Louis City Hospital, 1928-30; resident surgeon, 1930-33; private surgical practice, 1933-41; staff surgeon, St. Mary, Enid General, and Baptist Hospitals, Enid, Okla. Member, American Medical Association; Oklahoma State Medical Association; Garfield County Medical Association; fellow American College of Surgeons.

Katz, J. Harry, Lieutenant (MC) USNR (*The Absence of Skin Irritants in the Contents of Vesicles*, p. 1258). A. B., University of Pennsylvania, 1932; M. D., Hahnemann Medical College, Philadelphia, Pa., 1936. Resident physician, Hahnemann Hospital, Philadelphia, 1937; extern, New York Skin and Cancer Unit, New York Postgraduate Medical School and Hospital, New York, 1938-41; assistant dermatologist and syphilologist, New York Skin and Cancer Hospital, New York, 1941. Member Society of Investigative Dermatology; American Academy of Dermatology and Syphilology.

Knapp, Arthur A., Commander (MC) USNR (*Ocular Pathology in Various Types of Dietary Deficiencies With Particular Emphasis on Arteriolar Sclerosis; an Experimental Study*, p. 1339). M. D., University and Bellevue Hospital Medical College, 1926. Assistant eye surgeon, New York Eye and Ear Infirmary; research ophthalmologist, Department of Pharmacology, Columbia University, for several projects during 1931-38; assistant visiting eye surgeon and ophthalmologist, Arthritic Clinic, Hospital for Special Surgery (formerly Ruptured and Crippled Hospital); associate ophthalmologist, Montefiore Hospital for Chronic Diseases, 1931-40; director of eye service, Sing Sing Prison Hospital. Fellow American College of Surgeons; member American Medical Association; Association for Research in Ophthalmology; American Academy of Ophthalmology and Oto-Laryngology; New York Academy of Medicine.

Kolb, Lawrence C., Lieutenant (MC) USNR (*Combat Fatigue and War Neurosis*, p. 1299). B. A., Trinity College, Dublin University, 1932; M. D., School of Medicine, Johns Hopkins University, 1934. Intern, medicine and surgery, Strong Memorial Hospital, Rochester, N. Y., 1934-36; fellow, 1936-40; instructor in neurology, School of Medicine, Johns Hopkins University, 1940-41; assistant dispensary neurologist, Johns Hopkins Hospital, 1936-41; assistant visiting neurologist, Baltimore City Hospital, 1936-41; John and Mary Markle fellow in neurology, National Hospital, London, England, 1938-39; resident psychiatrist, Milwaukee Sanitarium, 1941-42. Baltimore City Medical Society; Society of Neurological Physiology. Certified, American Board of Neurology and Psychiatry, 1941-42. Coauthor, *Physiology of Micturition*, Wm. Wood & Co., 1940.

Lampson, R. Starr, Lieutenant (MC) USNR (*Sickbay Suggestions for Navy Schools*, p. 1444). A. B., Amherst College, 1930; M. D., Harvard Medical School, 1934. Surgical intern, Massachusetts General Hospital, 1934-36; resident surgeon, Pondville Hospital, 1936-37; private surgical practice, Hartford, Conn., 1937-; assistant visiting surgeon, Hartford. Member Hartford Medical Society; fellow American Medical Association; fellow American College of Surgeons. Certified, American Board of Surgery.

Lille, John J., Lieutenant Commander (MC) USNR (*Injuries of the Semilunar Cartilages of the Knee*, p. 1336). B. S., Pennsylvania State College, 1926; M. D., Long Island College Hospital, 1930. Intern, Bellevue Hospital, New York, 1930-32; resident in pathology, Coney Island Hospital, 1932-33; resident in surgery, Kings County Hospital, Brooklyn, N. Y., 1933-34; instructor, assistant attending in surgery, Long Island College Hospital, Brooklyn, N. Y., 1934-42; assistant attending in surgery, Kings County Hospital, Brooklyn, 1935-42; associate attending in surgery, Brooklyn Cancer Institute, 1938-42; adjunct in surgery, Beth Moses Hospital, Brooklyn, N. Y., 1934-42.

Lyons, Shirley C., Lieutenant Commander (MC) USNR (*The Mortality in Acute Appendicitis; Its Reduction by Diagnostic and Therapeutic Methods*, p. 1273). M. D., Tulane University, 1919. Intern, Charity Hospital of Louisiana, New Orleans, 1919-21; first assistant in surgery, Mayo Clinic, 1921-24; private practice, 1925-June 1, 1942; visiting surgeon, Southern Baptist Hospital and Hotel Dieu, New Orleans; visiting surgeon, Charity Hospital of Louisiana, New Orleans; instructor in gross anatomy, Tulane University, 1925-28, and instructor in clinical surgery, 1928-30; assistant professor in surgery, Louisiana State University medical Center, New Orleans, 1930-38. Member American Medical Association; Southern Medical Association; Louisiana State Medical Society; Orleans Parish Medical Society (Treasurer, 1934-36; First Vice President, 1936-37; President, 1937-38); American Board of Surgery, fellow American College of Surgeons; Alumni Association of the Mayo Clinic; New Orleans Academy of Sciences; Board of Directors of Hospital Service Association of New Orleans.

Mathews, William H., Lieutenant (MC) USNR (*Traumatic Ulnar Nerve Palsy: Neurolysis and Transposition of Nerve the Operation of Choice*, p. 1381). A. B., Colgate University, 1932; M. D., Harvard Medical School, 1936. Intern, Strong Memorial Hospital, 1936-37; resident, neuropsychiatry, 1937-39. Instructor, psychiatry, University of Rochester School of Medicine and Dentistry, 1939-42; psychiatrist, Rochester (N. Y.) City Courts, 1939-42. Member American Psychiatric Association.

McLaughlin, Charles W., Jr., Lieutenant Commander (MC) USNR (*Complete Rupture of the Tendo Achillis; Report of a Case*, p. 1388). B. S., University of Iowa, 1927; M. D., Washington University School of Medicine, St. Louis, 1929. Resident in pathology, Montreal General Hospital, 1930-31; fellow in surgery, University of Pennsylvania Hospital, 1931-34; graduate study, Royal Infirmary, Edinburgh, Scotland, 1934-35; private practice, Omaha, 1935-; assistant professor surgery, University of Nebraska; surgeon, University of Nebraska Hospital, Nebraska Methodist Hospital and Bishop Clarkson Memorial Hospital, Omaha. Certified, American Board of Surgery. Member Nebraska State Medical Society; American Medical Association; Central Surgical Association; American College of Surgeons; Western Surgical Association.

Older, Harry P., Lieut. (jg) H-V(S) USNR (*Detection of Malingering Through Psychometric Tests*, p. 1318). A. B., 1939, and M. S., 1941, Fort Hays' Kansas State College; Ph. D., Clark University, 1942. Member, Eastern Psychological Association; associate member, American Psychological Association.

Penn, Herschel, Lieutenant (MC) USNR (*A Simple Method for Extremity Immobilization*, p. 1432). M. D., University of Tennessee, 1930. Intern, Knickerbocker Hospital, New York, July 1930-January 1931; New York Polyclinic Hospital, January 1931-October 1932; resident orthopedic surgeon, Research and Educational Hospital, University of Illinois, 1933-1934; fellowship, orthopedic surgery, Carrell-Girard Clinic, Dallas, Tex., 1 year. Attending orthopedic surgeon, Knoxville General Hospital, Knox County Crippled Children's Hospital, Fort Sanders Hospital, St. Mary's Memorial Hospital, Knoxville, Tenn.; designated orthopedic surgeon, Tennessee Crippled Children's Commission. Member Knox County Medical Society; Tennessee State Medical Society; Southern Medical Association; American Medical Association; fellow, American College of Surgeons; diplomate, American Board of Orthopedic Surgery; fellow, American Academy of Orthopedic Surgeons.

Peterson, Thomas H., Commander (MC) USNR (*Injuries of the Semilunar Cartilages of the Knee*, p. 1336). M. D., Northwestern University Medical School, 1926; intern, St. Luke's Hospital, Chicago, 1925-27; assistant visiting surgeon, Boston City Hospital and New England Baptist Hospital; assistant visiting orthopedic surgeon, New England Medical Center; instructor, Harvard Medical School and Tufts Medical School. Member American College of Surgeons; Boston Orthopedic Club; American Medical Association; Massachusetts Medical Society.

Russell, Hollis K., Lieutenant Commander (MC) USNR (*Acute Hemolytic Anemia Associated with Leukemoid Reaction Following Administration of Sulfanilamide*, p. 1399). A. B., Washington College, 1924; M. D., College of Medical Evangelists, 1929. Resident and assistant pathologist, Grasslands Hospital, Valhalla, N. Y., 1930-35; hematologist, Grasslands Hospital, 1935-; pathologist, St. Agnes Hospital, White Plains, N. Y., 1935-; pathologist, Yonkers Professional Hospital, 1940-. American Medical Association; New York State Medical Society; Medical Society of the County of Westchester; New York State Association of Public Health Laboratories; New York State Society of Pathologists; American Association of Pathologists and Bacteriologists; diplomate, American Board of Pathology, Clinical and Anatomic.

Sanford, Shelton P., Lieutenant Commander (MC) USNR (*Carbon Tetrachloride Poisoning*, p. 1486). A. B., 1916, and A. M., 1917, University of Georgia; M. D., Harvard Medical School, 1926. Intern, Boston City Hospital, 1926-27; medical resident, 1927-28, and chief resident, 1928, Grady Hospital, Atlanta.

Ga.; instructor in medicine, Emory University, November 1927–September 1929; U. S. Public Health Service, Savannah, Ga., December 1930.

Scott, Wendell G., Lieutenant Commander (MC) USNR (*A New Emergency Transport Splin of Plyformed Wood*, p. 1424). M. D., Washington University (St. Louis), 1932. Intern, Barnes Hospital, 1933–34; instructor, radiology, Washington University, 1934–38. Certified, radiology, 1937. Assistant radiologist: Barnes Hospital; Edward Mallinckrodt Institute of Radiology; St. Louis Children's Hospital. Assistant professor clinical radiology, Washington University. Member American College of Radiology; American Medical Association; National Gastro-Enterological Association; Radiological Society of North America; Southern Medical Association.

Shelton, Joseph M., Lieutenant (MC) USNR (*Contact Dermatitis From Black Cotton Socks*, p. 1408). B. S., 1930, and M. D., 1933, University of Pittsburgh. Assistant, Anatomy Department, University of Pittsburgh, 1929–31; intern, Mercy Hospital, Pittsburgh, 1933–34; resident in pathology, Mercy Hospital, 1934–35; resident in dermatology and syphilology, Pittsburgh Skin and Cancer Foundation, 1935–38; senior staff member in dermatology, Washington (Pa.) Hospital, 1938–; dermatological staff, Pittsburgh Skin and Cancer Foundation, 1938–. Member American Medical Association, American Academy of Dermatology; Central States Dermatological Society; Society for Investigative Dermatology; Pittsburgh Dermatological Society. Certified by American Board of Dermatology and Syphilology, 1940.

Solomon, Philip, Lieutenant Commander (MC) USNR (*Electroencephalography in the selection of Naval Recruits*, p. 1310). B. S., Harvard College, 1926; M. D., Harvard Medical School, 1930. Resident neurologist, Boston City Hospital, 1932–33; assistant in neurology, Harvard Medical School, 1932–33; Austin teaching fellow, neuropathology, Harvard Medical School, 1933–34; Austin teaching fellow, neurology, Harvard Medical School, 1934–35; junior visiting neurologist, Boston City Hospital, 1935–; assistant physician, Boston Psychopathic Hospital, 1935–36; assistant psychiatrist, Massachusetts General Hospital, 1935–36; assistant in neurology, Harvard Medical School, 1936–; research assistant in psychology, Brown University, 1936–37; senior psychiatrist, Massachusetts Department of Mental Health, 1937–38; psychiatrist, Habit Clinic for Child Guidance, Boston, 1937–; consulting psychiatrist, New Hampshire Children's Aid Society, 1937–41; private practice; instructor in psychiatry, Tufts Medical School; and junior visiting neurologist, Beth Israel Hospital, Boston, 1938–41. A. M. A.; Massachusetts Medical Society; Boston Society of Neurology and Psychiatry; Massachusetts Psychiatric Society; American Orthopsychiatric Society. Certified by American Board of Neurology and Psychiatry.

Stabins, Samuel J., Lieutenant Commander (MC) USNR (*Traumatic Ulnar Nerve Palsy; Neurolysis and Transposition of Nerve the Operation of Choice*, p. 1381). M. D., Emory University School of Medicine, 1925. Intern, New Haven Hospital, 1925–26; surgical pathology, Yale University Medical School, 1926, surgeon in charge, Experimental Animal Laboratory, University of Rochester School of Medicine and Dentistry, 1926–27; assistant in surgery, University of Rochester School of Medicine and Dentistry, and assistant resident surgeon, Strong Memorial Hospital, 1927–28; instructor, surgery, and resident surgeon, Strong Memorial Hospital, 1928–29; instructor, surgery, University of Rochester School of Medicine and Dentistry, 1929–35; assistant professor of surgery, 1935–. Member American Board of Surgery; president Society of University Surgeons, 1939–40.

Sulzberger, Marion B., Commander (MC) USNR (*The Absence of Skin Irritants in the Contents of Vesicles*, p. 1258). B. S., Harvard, 1916; University Geneva, Switzerland, 1921; B. M. Sc., Sorbonne, Paris, 1922; M. D., University Zurich, Switzerland, 1926. Assistant, University Clinic (dermatology and syphilology), Zurich, 1926-29; Breslau, 1929; associate and instructor, dermatology, New York Post-Graduate Medical School and Hospital, New York City, 1929-35, assistant professor, clinical dermatology, 1935-38, and assistant clinical professor, dermatology and syphilology, 1938-; associate attending, New York Post-Graduate Hospital, 1935-38, attending, 1938-; associate attending dermatologist, Montefiore Hospital, 1931-; director dermatology and syphilology dept., French Hospital, 1934-38; consultant in dermatology, 1938; visiting physician, Welfare Hospital, 1941-; research associate in medicine, Cornell University Medical College, New York City, 1942-. Member American Medical Association; American Dermatological Association; American Academy of Dermatology and Syphilology; American Society for the Study of Allergy; American Association of Immunologists; Bronx Dermatological Society; Society for Experimental Biology and Medicine; Society for Investigative Dermatology; Society for the Study of Asthma and Allied Conditions; Society for Research in Psychosomatic Problems; fellow New York Academy of Medicine. Editor, Year Book of Dermatology and Syphilology, 1931-; Board of Editors, Journal of Allergy, Psychosomatic Medicine, Dermatologica; editor, Journal of Investigative Dermatology, 1938-. Author, Dermatologic Allergy, C. C. Thomas, 1938; co-author, Dermatologic Therapy in General Practice, Year Book Publishers, 1940, 2d edition 1942; co-author, Manual of Dermatology, W. B. Saunders, 1942.

Sulzman, John H., Lieutenant (MC) USNR (*Powdered Sulfathiazole in the Treatment of Conjunctivitis*, p. 1396). B. S., Manhattan College, 1928; M. D., Columbia University, 1932. Resident in ophthalmology, 1934-35, resident in otolaryngology, 1935-37, and assistant surgeon, ophthalmology, 1937-. New York Eye and Ear Infirmary; junior surgeon, 1937-38, and surgeon, ophthalmology and otology, 1938-, Troy Hospital; junior surgeon, 1937-38, and surgeon (ophthalmology, oto-rhino-laryngology), 1938-, Cohoes Hospital, Cohoes, N. Y. Member Rensselaer County (N. Y.) Medical Society; Northeastern New York Eye, Ear, Nose, and Throat Association; New York State Medical Society; American Medical Association; American Academy of Ophthalmology and Otolaryngology; diplomate, National Board of Medical Examiners; American Board of Ophthalmology; American Board of Otolaryngology.

Taylor, K. P. A., Lieutenant Commander (MC) USNR (*Complete Venereal Prophylaxis with a Sulfa-Mercury Compound*, p. 1488). B. S., Haverford College, 1915; M. D., University of Pennsylvania, School of Medicine, 1919. Surgeon resident, University of Pennsylvania Hospital; chief surgical resident, Hospital Santo Tomas, Panama, R. de P.; formerly chief surgeon, Hospital Cartagena, Cartagena, Colombia, S. A.; instructor in surgery, University of Pennsylvania, School of Medicine; assistant surgeon, Philadelphia General Hospital, Howard and Stetson Hospitals; assistant urologist, St. Agnes and St. Mary's Hospitals, Philadelphia; attending surgeon, Anglo-American Hospital, Havana, Cuba; superintendent and chief Surgeon, United Fruit Co. Hospital, Panama. Diplomate National Board, Medical Examiners; fellow American College of Surgeons; member Philadelphia County Medical Society; Pennsylvania Medical Society; American Medical Association.

Viles, Frederick J., Lieut. (jg) II-V(S) USNR (*Nasal and Pharyngeal Irritation from Contact with Sucrose Octa Acetate among Operators of Compressed Air Hammers*, p. 1378). B. S., Massachusetts Institute of Technology, 1938. Indus-

trial hygienist, Liberty Mutual Insurance Co., Boston, Mass., 1938-41. Member American Industrial Hygiene Association; American Chemical Society.

Warren, Shields, Lieutenant Commander (MC) USNR (*The Pathological Aspects of Acute Pharyngeal Infections*, p. 1252). A. B., Boston University, 1918; M. D., Harvard Medical School, 1923. Assistant professor of pathology, Harvard Medical School; pathologist to New England Deaconess Hospital, Harvard Cancer Commission, New England Baptist Hospital, Pondville State Hospital for Cancer; director of State Tumor Diagnosis Service; Member American Association of Pathologists and Bacteriologists; American Association for Cancer Research (Vice President, 1941-42; President, 1942-); American Society for Experimental Pathology (Secretary-Treasurer, 1934-37; Vice President, 1939-1940; President, 1940-41); Society for Experimental Biology and Medicine; Massachusetts Medical Society; American Medical Association; New England Pathological Society; American Association for the Advancement of Science. Member of editorial staffs of New England Journal of Medicine, Cancer Research, American Journal of Pathology. Author, *Medical Science for Everyday Use*, Lea & Febiger, 1927; *Pathology of Diabetes Mellitus*, Lea & Febiger, 1st edition, 1930, 2d edition, 1938.

Webster, George V., Lieutenant (MC) USNR (*A New Needle-Holder for Plastic Surgery*, p. 1434). Stanford University, 1928-1932; M. D., Stanford University School of Medicine, 1937. Intern, surgery, Stanford-Lane University Hospital, 1936-37, assistant resident, surgery, 1937-38; assistant in pathology, Stanford University, and assistant visiting pathologist, San Francisco Hospital, July 1938-January 1939; surgical house officer, Stanford-Lane University Hospital, January 1939-July 1939; junior resident in surgery, Presbyterian Hospital, New York City, and assistant in surgery, Columbia University College of Physicians and Surgeons, July 1939-July 1940; resident in surgery (plastic and reconstruction) Presbyterian Hospital, New York City, July 1940-January 1942.

Weeks, Carnes, Lieutenant Commander (MC) USNR (*The Conversion of a Navy Standard Operating Table into a Fracture Table*, p. 1413). Ph. B., Yale Sheffield Scientific School, 1920; M. D., College of Physicians and Surgeons, Columbia University, 1923. Intern and resident in surgery, Bellevue Hospital, 1924-27; pathological intern, Presbyterian Hospital, 1926; associate attending surgeon, New York Postgraduate Hospital; adjunct attending surgeon and chief of Surgical Clinic, Bellevue Hospital; instructor in surgery, College of Physicians and Surgeons, Columbia University, 1927-42; instructor in anatomy, 1927-38. Fellow American College of Surgeons; member New York Surgical Society; American Board of Surgery.

Wienman, George J., Lieutenant (MC) USNR (*Sympathetic Ophthalmitis; Report of 4 Cases*, p. 1392). B. S., University of Illinois, 1936; M. D., 1938. Intern, Cook County Hospital, 1938-40; resident in Department of Otolaryngology and Ophthalmology, 1940-42.

Wittson, Cecil L., Lieutenant Commander (MC) USNR (*Electroencephalography in the Selection of Naval Recruits*, p. 1310). B. S., University of South Carolina, 1928; M. D., Medical College State of South Carolina, 1931. Instructor, biology, University of South Carolina, 1927; intern, neuropsychiatry, Central Islip State Hospital, N. Y., 1932-33; instructor, psychoanalysis, New York Psychoanalysis Inst., 1933; neuropsych., College of Physicians and Surgeons, Columbia University, 1935; attending psychiatrist, New York State Psychiat. Inst. and Hospital, 1935-37; assistant physician, Central Islip State Hospital, N. Y., 1933-36; senior assistant, 1936-40.



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MEDICAL DEPARTMENT *of the* NAVY

BIMONTHLY



THE MISSION OF THE MEDICAL CORPS OF THE NAVY

**TO KEEP AS MANY MEN AT AS MANY GUNS
AS MANY DAYS AS POSSIBLE**

**Issued Bimonthly by the Bureau of Medicine and Surgery
Washington, D. C.**

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DIVISION OF PUBLICATIONS
THE BUREAU OF MEDICINE AND SURGERY

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of professional interest.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T MCINTIRE,
Surgeon General, United States Navy.

III

NOTICE TO CONTRIBUTORS

Contributions to the BULLETIN should be typewritten, double spaced, on plain paper and should have wide margins. Fasteners which will not tear the paper when removed should be used. Nothing should be written in the manuscript which is not intended for publication. For example, addresses, dates, etc., not a part of the article, require deletion by the editor. The BULLETIN endeavors to follow a uniform style in heading and captions, and the editor can be spared much time and trouble, and unnecessary changes in manuscript can be obviated if authors will follow in these particulars the practice of recent issues.

The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have them typewritten.

In submitting articles for publication either in the BULLETIN or in other journal, the author should include a signed statement to the effect that "the opinions or assertions contained therein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large." (Art. 113 (2) U. S. Navy Regulations.) If forwarded for publication in other journal the article must be submitted in duplicate, one copy being retained in the Navy Department files.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized. Recognizable photographs of patients should carry with them permission to publish.

The BULLETIN intends to print only original articles, translations in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication. Authors are urged to keep their papers short. A lengthy, otherwise excellent article will very often lose readers, appalled by its mass.

The editor regrets to have to say that reprints of articles can no longer be supplied by the Government Printing Office.

ROBERT C. RANDELL, *Editor,*
Commander, Medical Corps,
United States Naval Reserve.
STEPHEN A. ZIEMAN, *Assistant Editor,*
Lieutenant Commander, Medical Corps,
United States Naval Reserve.

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U. S. NAVAL MEDICAL BULLETIN

VOL. XLI

NOVEMBER 1943

No. 6

SPECIAL ARTICLES

FOREWORD TO SYMPOSIUM ON FIRST YEAR OF ACTIVITIES AT U. S. NAVAL BASE HOSPITAL ———

JOHN E. PORTER

Captain (MC) U. S. N.

At the suggestion of the Surgeon General of the Navy, the medical and dental officers comprising the staff of United States Naval Base Hospital ——— have prepared a series of reports describing the activities of the various departments during the first year of the operation of this hospital. This advance base hospital was the first to be established in the South Pacific area. It is hoped that the lessons learned in this pioneering endeavor will be of value to those about to engage in similar tasks.

The urgency of the military situation at the time of the departure from the United States of the hastily assembled staff provided little opportunity for orientation to the tasks lying immediately ahead. Adjustments had to be made and lessons learned in the hard but effective school of experience. Happily, the medical and dental officers selected for this enterprise were for the most part thoroughly qualified specialists in their respective fields of medical practice. All but the commanding officer and the executive officer were reservists, largely inexperienced in naval customs and traditions and in naval hospital practices. Their accomplishments testify to their high sense of loyalty and adaptability. From the outset, the organization has been dominated by a sense of unselfish devotion to duty and an unremitting zeal to provide wounded and sick officers and men with the best professional service that modern medicine has to offer.

It was apparent from the type of buildings and equipment provided by the Bureau of Medicine and Surgery that nothing short of such a high standard would be acceptable. The high qualities of performance of both personnel and matériel is reflected in the exceedingly low mortality rate and in the high proportion of sick and wounded officers and enlisted men who were restored to a duty status.

The reports which follow tell, in an objective and restrained manner, but with a slight undercurrent of pardonable pride, how medical

and dental officers and hospital corpsmen unloaded ships, built roads, constructed huts, installed water and sanitary facilities, set up a temporary hospital to care for several hundred patients while constructing the base hospital, amid the heat, humidity, and primitive environment of a small island in the deep tropics. The fact that they labored in a position constantly exposed to enemy action acted only as a challenge to complete the job quickly. The reward for this effort came when the new hospital was commissioned at the very time that the first waves of casualties arrived by ambulance planes and ships from the scenes of land and sea action a few hundred miles away.

Supplementing the high standard of professional service rendered by the medical and dental officers was the skillful care given to the patients by the hospital corpsmen and, during recent months, by members of the Navy Nurse Corps. Many of the hospital corpsmen had little or no hospital experience. A high proportion were fresh from college, from business offices, factories, or farms. A hospital corps school was organized on the transport vessel immediately after departure from the United States and has been continued on a larger scale since that time.

In a remarkably short time, this heterogeneous group of inexperienced but eager young men was molded into an efficient, smoothly functioning organization.

One outstanding feature of both the military and the medical activities at this base has been the remarkably successful unity of effort by the various branches of the armed services. Before arriving at this base, the Commanding Officer of United States Naval Base Hospital ——— was appointed by the Commanding General of the Force to act as the Force Surgeon. From the outset the activities of medical officers of the Army and Navy and of those naval medical officers attached to Marine Corps organizations at this base have been characterized by close and effective collaboration. The regularly conducted clinical conferences at this hospital have been attended by the medical officers attached to the Army, Navy, and Marine Corps and to the military organizations of our Allies. Regular tours of inspection have been made by the Force Surgeon to all outlying sickbays, and to aid stations and hospitals on the base. The close integration of the work of the various medical activities on the base was reflected in the high quality of work performed by all.

Despite the unavoidable confinement for many months to a small tropical island, with little opportunity for normal recreational outlets, the esprit de corps of both officers and enlisted men has remained at a constantly high level. Perhaps the best explanation for the excellent morale lies in the day-by-day sense of personal reward for accomplishing the mission to which they were assigned. This enterprise has been, in the best naval tradition, an "all hands evolution."

A. THE GENESIS AND DEVELOPMENT OF U. S. NAVAL BASE HOSPITAL ———

FREDERICK W. MULLER
Captain (MC) U. S. N.

During the last week in March 1942, 33 medical officers, 2 dental officers, and 4 pharmacists received orders to report to the Commandant, 12th Naval District, on or before 6 April, 1942. Included in this group were the United States Naval Reserve Specialist Unit from Dayton, Ohio, a United States Naval Reserve Specialist Unit from St. Louis, Mo., other physicians from Los Angeles, Calif., and from many other cities throughout the country. The original roster follows:

Capt. John E. Porter (MC) U. S. N., Commanding Officer.
Capt. Frederick W. Muller (MC) U. S. N., Executive Officer.
Capt. Walter M. Simpson (MC) U. S. N. R., Chief of Medicine.
Capt. John M. Schmoele (MC) U. S. N. R., Chief of Surgery.
Commander Oliver W. Butler (MC) U. S. N. R.
Commander William H. Leake (MC) U. S. N. R.
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Lt. Comdr. Charles B. Beymer (MC) U. S. N. R.
Lt. Comdr. Thomas P. Sharkey (MC) U. S. N. R.
Lt. Comdr. Lee C. Bird (MC) U. S. N. R.
Lt. Comdr. William L. Powers (MC) U. S. N. R.
Lt. Comdr. James M. Macnish (MC) U. S. N. R.
Lt. Comdr. Elmer F. Hartwig (DC) U. S. N. R.
Lt. Comdr. Elmer M. Bingham (MC) U. S. N. R.
Lt. Comdr. Manley B. Shaw (MC) U. S. N. R.
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Lt. George M. Cazan (MC) U. S. N. R.
Lt. Elmer Ridgeway, Jr. (MC) U. S. N. R.
Lt. (junior grade) Noel A. Deal (HC) U. S. N.
Lt. (junior grade) Ronald Osborn (HC) U. S. N.
Lt. (junior grade) George F. Bradford (HC) U. S. N.
Lt. (junior grade) Robert M. Drowne (HC) U. S. N.

Three of the above mentioned officers subsequently were returned to the United States because of physical disabilities. During later months, the following named officers reported for duty at this hospital:

Commander Henry H. Kessler (MC) U. S. N. R.
Lt. Comdr. Philip W. McKenney (MC) U. S. N. R.
Lt. John D. Charles (MC) U. S. N. R.
Lt. Comdr. Fred A. Butler (MC) U. S. N.
Lt. Robert G. Lehman (MC) U. S. N.
Lt. Marvin C. Becker (MC) U. S. N. R.
Lt. Francis O. Fry (MC) U. S. N. R.
Lt. Ray R. Rueckert (MC) U. S. N. R.
Lt. Jacob I. Essig (DC) U. S. N. R.
Lt. James W. Fulton, Jr. (ChC) U. S. N. R.
Lt. (junior grade) Willis H. Taylor (MC) U. S. N.
Lt. (junior grade) Robert L. Endsley U. S. N.
Pharmacist Millard E. Pate U. S. N. R.
Boatswain John A. Cooke U. S. N.
Pharmacist Albert H. Nelson U. S. N.
Ensign George E. Harris (HC) U. S. N.
Pharmacist Wayne B. Hewitt U. S. N.

On December 31, 1942, the following members of the Navy Nurse Corps reported for duty at this hospital:

Lt. (junior grade) Ida M. Istad (NC) U. S. N.
Lt. (junior grade) Thelma F. Laird (NC) U. S. N. R.
Lt. (junior grade) Thora L. Wellman (NC) U. S. N. R.
Lt. (junior grade) Mary E. Carter (NC) U. S. N.
Lt. (junior grade) Thelma R. Bare (NC) U. S. N.
Lt. (junior grade) Ellen L. Lechner (NC) U. S. N. R.
Lt. (junior grade) Teresa M. Hayes (NC) U. S. N. R.
Ensign Theda A. McKim (NC) U. S. N. R.
Ensign Blanche A. Green (NC) U. S. N.
Ensign Mary G. Dudley (NC) U. S. N.
Ensign Aileen J. Maguire (NC) U. S. N.
Ensign Mercedes Hall (NC) U. S. N. R.
Ensign Caroline M. Hunter (NC) U. S. N. R.
Ensign Jessie V. Boling (NC) U. S. N. R.
Ensign Dorothy J. Davis (NC) U. S. N. R.
Ensign Kathryn P. Hawkins (NC) U. S. N. R.
Ensign Anna M. Spiekerman (NC) U. S. N. R.
Ensign Martha L. Heilman (NC) U. S. N. R.
Ensign Ruth W. Johnson (NC) U. S. N. R.
Ensign Ila M. Pederson (NC) U. S. N. R.
Ensign Barbara L. Norris (NC) U. S. N. R.
Ensign Mary A. Vaughn (NC) U. S. N. R.

Ensign Anne E. Bayh (NC) U. S. N.
Ensign Sarah P. Gray (NC) U. S. N. R.
Ensign Alice M. Rothermel (NC) U. S. N. R.

On March 15, 1943, the following additional members of the Navy Nurse Corps reported for duty at this hospital:

Lt. (junior grade) Carol M. Perry (NC) U. S. N.
Lt. (junior grade) Rita V. O'Neill (NC) U. S. N.
Lt. (junior grade) Evelyn D. Glancy (NC) U. S. N. R.
Lt. (junior grade) Alma C. Ballantyne (NC) U. S. N.
Lt. (junior grade) Mary L. Guderian (NC) U. S. N.
Lt. (junior grade) Clara G. Hemme (NC) U. S. N. R.
Lt. (junior grade) Alma A. Schumacher (NC) U. S. N. R.
Ensign Dora S. Brooks (NC) U. S. N.
Ensign Edith M. Williams (NC) U. S. N.
Ensign Martha A. Hunter (NC) U. S. N. R.
Ensign Berniece C. Sigmund (NC) U. S. N. R.
Ensign Wilna O. Wixom (NC) U. S. N. R.
Ensign Lorita B. Swift (NC) N. S. N.
Ensign Hester M. Jones (NC) U. S. N. R.
Ensign Dorothy M. Bacon (NC) U. S. N.
Ensign Frances M. Aue (NC) U. S. N.
Ensign Dorothy G. Baker (NC) U. S. N. R.
Ensign Marie B. Goldthwaite (NC) U. S. N. R.
Ensign Irene O. Carlson (NC) U. S. N.
Ensign Katherine E. Jones (NC) U. S. N. R.
Ensign El Dula Dean Wixom (NC) U. S. N. R.
Ensign Margrethe H. Soelberg (NC) U. S. N. R.
Ensign Annette L. Morris (NC) U. S. N. R.
Ensign Dorothy W. Coutant (NC) U. S. N. R.
Ensign Marian E. Murphy (NC) U. S. N. R.

After 6 days' preparation time, the convoy departed from a west-coast port. During the voyage the 239 hospital corpsmen were interviewed and classified in respect to their future assignments, and in small groups received instructions daily in professional subjects. An intensive refresher course in tropical medicine and war medicine, consisting of 2 lectures daily, was conducted for the medical officers.

On May 4, 1942, the convoy reached its destination in the South Pacific. The urgency of the military situation at this advance base, the first to be established in the South Pacific, demanded that all medical officers, hospital corpsmen, and members of the naval construction battalion disembark and commence unloading operations immediately. Medical officers were assigned the duties of deck officers, supervising the removal of cargo from the holds, lighterage, and the unloading and trucking operations ashore. Hospital corpsmen acted as stevedores, winchmen, truck drivers, and boat crews. The remarkable features of these day and night unloading operations by inexperienced personnel were the rapidity with which more than 40,000 tons

of cargo were discharged and the fact that not a single person so engaged sustained any injury.

While unloading operations were progressing, a survey was made of conditions ashore relative to the establishment of temporary hospital facilities and living quarters for personnel. From the few buildings suitable for such purposes, a small civilian hospital, a court building, a church, and 8 residences were selected. This provided for the hospitalization of 450 patients and the housing of medical officers and hospital corpsmen. This temporary hospital was in operation from May 5, 1942, to September 18, 1942.

A major share of the construction was accomplished by the hospital corpsmen under supervision of officers of a naval construction battalion and of medical officers assigned to this duty.

The new hospital was commissioned on September 19, 1942, at which time 387 patients were moved from the temporary hospital buildings in the small town.

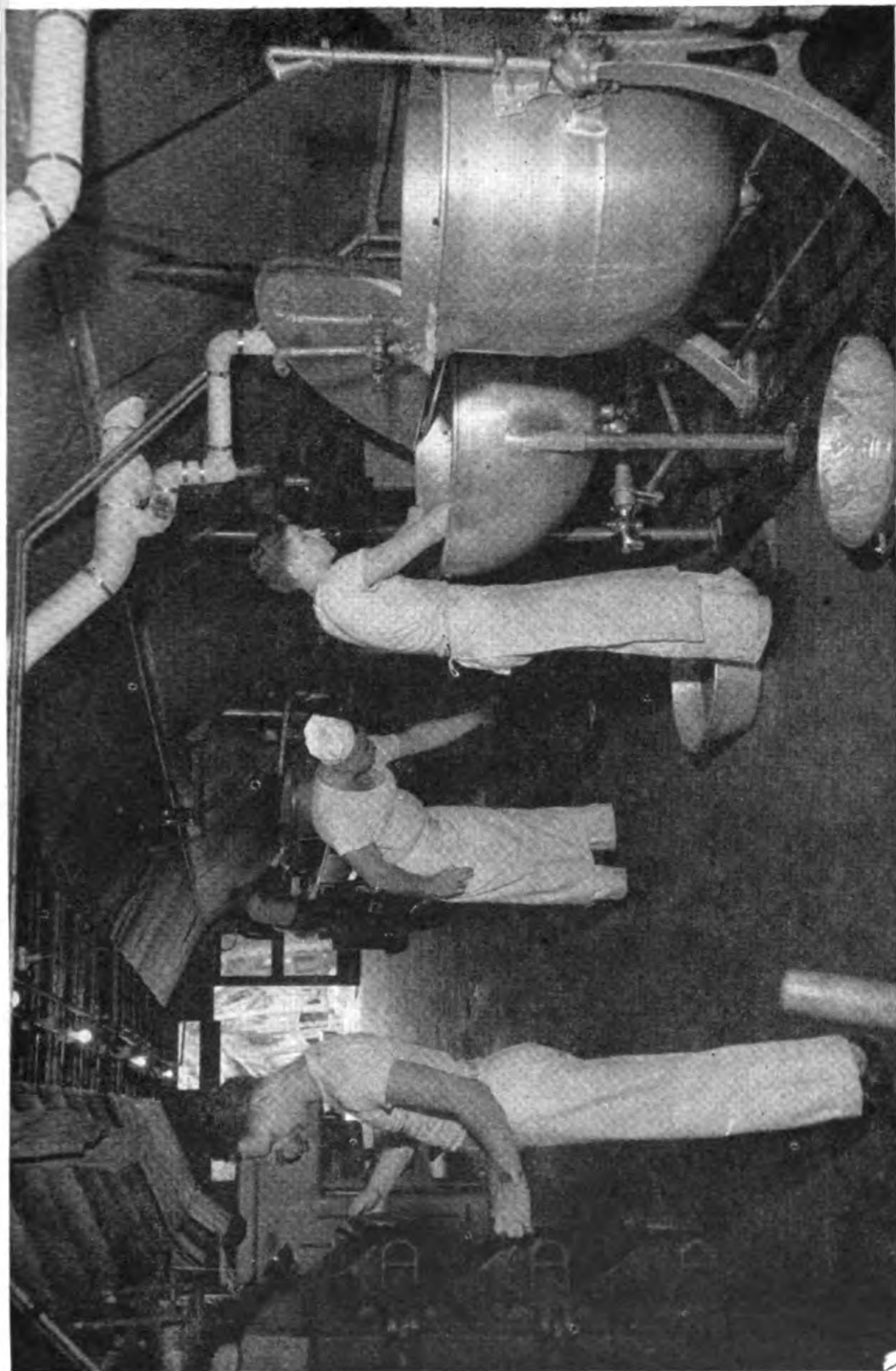
The island on which this hospital is located is of medium size. The basic formation consists of a lava understratum covered with coral and a top soil of rich humus. The vegetation is tropical and a large portion of the island is covered with dense jungle. There are several mountain ranges reaching an elevation of approximately 2,200 feet. Nearly one-half of the population resides in or near the small town.

Scattered over the island, particularly along the shore, are numerous large plantations, owned by foreign nationals. The chief products are copra, cacao, and coffee. Most of the laborers on the plantations are Tonkinese (Indo-Chinese), brought here on a contract-labor basis.

The naval hospital occupies 60 acres of a cocoanut plantation at an elevation of approximately 500 feet, located $2\frac{1}{2}$ miles from the principal town and harbor. The terrain is rolling and the top soil of clay and humus is several feet in depth. This formation does not provide natural drainage and makes the construction and maintenance of roads and drainage ditches a difficult and continuous problem. The principal roads have been constructed of coral, the only road-building material available. This type of construction requires constant upkeep. Suitable drainage ditches for handling the surface water, resulting from the torrential rains peculiar to this locality, had to be constructed.

The source of water supply is a river and a creek, located approximately 4 miles from the hospital reservation. The watershed is an impenetrable jungle and is uninhabited. Water is present in these streams in abundance throughout the year.

The purification system consists of one 60 g. p. m. American water purification unit of the rapid sand filtration and chlorination type with facilities for coagulation with aluminum sulfate. There are also two 25 g. p. m. Wallace & Tiernan portable pumping units. Two



1. Galley, U. S. Naval Base Hospital ———.

300-pound booster pumps of the Chrysler type force the water through a 4-inch main to storage tanks on the hospital reservation. These consist of three tanks, each of 50,000 gallon capacity, and one tank of 5,000 gallon capacity.

The water is crystal clear and potable. Chemical analysis shows a high calcium carbonate content (9.5 gr. per million gallons), capable of being softened by a coagulation process. Bacteriological examinations of specimens collected from the mains are made routinely each month and more frequently when deemed advisable. At all times, the specimens have been free from colon bacilli and the organisms of the aerogenes group. There have been no outbreaks of disease attributable to water contamination.

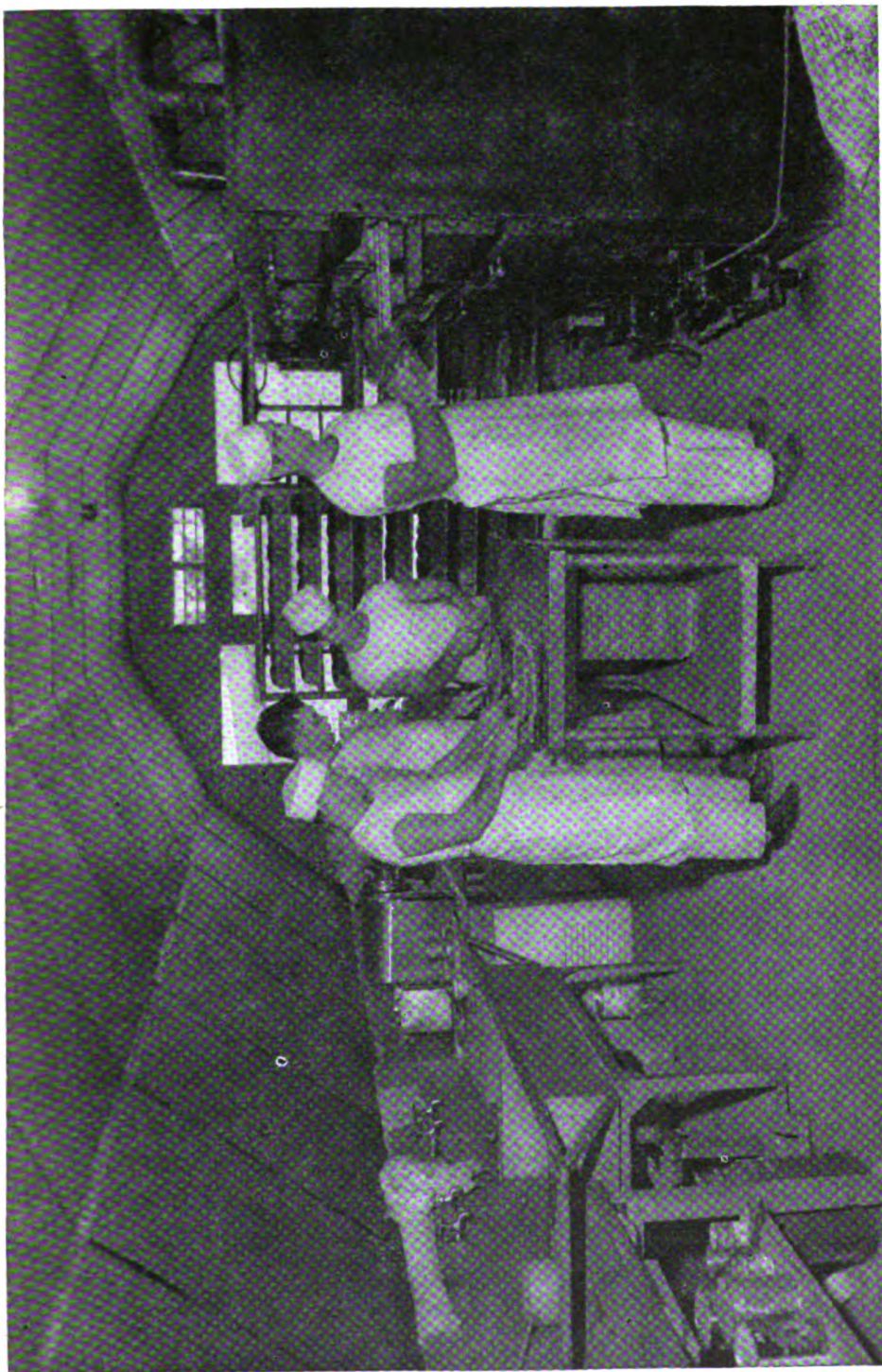
The buildings are the Quonset, the Iceland, and the Butler type metal huts, together with sheds constructed of wood and metal. As required, these huts are used as single units or in groups of two or three placed end to end. There are in all 203 building units, including 6 sheds. Covered boardwalks extend from the commissary area to the various wards, operating suites, x-ray department, dental department and laboratories.

There are 30 wards, including sick officers' quarters. Of this number, 12 wards are for medical cases, 14 are for surgical cases, and 4 are isolation wards. The isolation wards include 3 wards for the isolation and treatment of patients with dysentery, and 1 isolation ward which has been used chiefly for patients with gas bacillus infection. There are 4 wards for neuropsychiatric cases, including 1 open ward, 1 lock ward, and 2 wards with lock rooms. The surgical wards include wards for general surgery, 1 ward for pulmonary surgical cases, 2 orthopedic wards; 1 eye, ear, nose, and throat ward; and a ward for urological cases. The sick officers' quarters consist of 2 medical wards and 1 surgical ward.

These wards provide a bed capacity of 600 permanent beds, capable of expansion to 1,000 with the addition of cots. On several occasions the hospital has had between 800 and 1,000 patients. New construction is under way to provide 1,000 permanent beds and space for 500 cots.

There are two complete surgical units, each consisting of two operating rooms, a sterilizer room and a washroom. These units are widely separated for dispersal purposes and are connected by covered board walks with the various surgical activities. The facilities are adequate, with modern lighting and all necessary equipment.

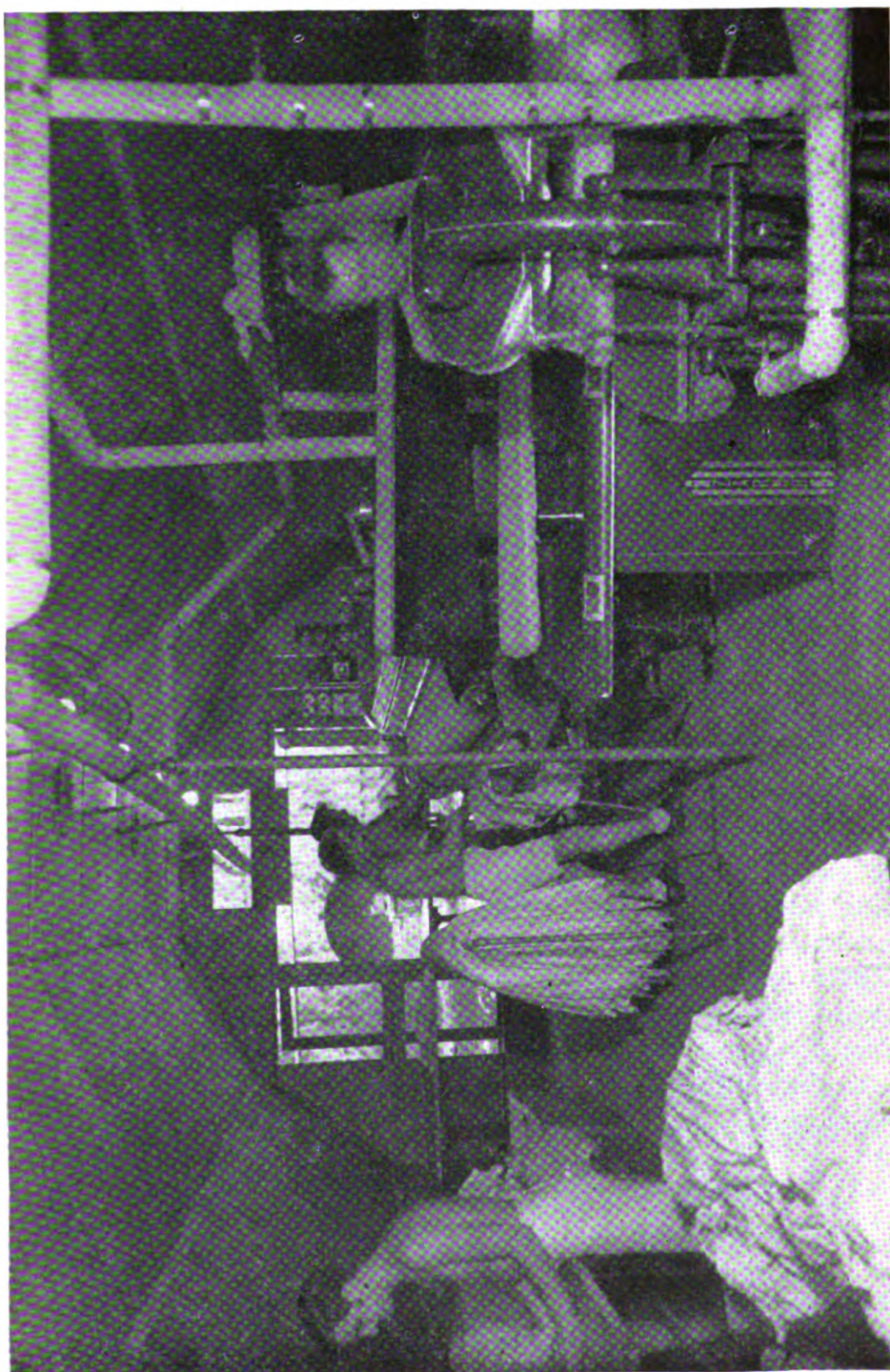
During the first few months after arrival, the food problem, as it related to patients, was a serious one. The field rations supplied by the Army quartermaster during that time did not provide fresh vegetables, fresh eggs, butter, or fresh milk. Some vegetable seeds



2• Bake Shop, U. S. Naval Base Hospital ———.



3. Washing room showing modern laundry equipment in use, U. S. Naval Base Hospital ———.



4. Ironing and pressing equipment, U. S. Naval Base Hospital ———.

were brought from the United States and additional supplies of seeds were obtained through local sources. Contracts were made with local planters to raise fresh vegetables for use at the hospital, with the result that during the past 8 months there has been an abundant and constant supply of fresh vegetables. The results of this enterprise have been reflected in the provision of an adequately balanced diet for the patients. The local supplies of eggs and fresh meat have been augmented by shipments received at various times from the United States and New Zealand.

One of the chief goals of the staff was to return to active duty as many patients as possible. Only those patients whose disabilities were such that they could not be restored to duty status within 2 months were evacuated. Sixty-five percent of all patients were returned to duty, while 35 percent were evacuated by hospital and ambulance ships. Many of these patients were subsequently returned to duty in the South Pacific area.

One of the most remarkable and successful features of this enterprise has been the smooth integration of the ambulance-plane transportation of patients from the scenes of land or sea combat with their prompt arrival at this hospital and the subsequent evacuation of selected patients by hospital or ambulance ships. The ambulance planes were well equipped for the transportation of both stretcher and ambulatory patients. The pilots of these unarmed planes performed their duties magnificently, flying often under the trying conditions of unfavorable weather and harassment by the enemy. In each plane a medical officer or a hospital corpsman accompanied the patients and administered such supportive measures as were required. Often, men who had been wounded during the early hours of the morning would be received at this hospital during the afternoon of the same day. Medical officers and hospital corpsmen met each plane with the required number of ambulances. If further first-aid measures were indicated they were administered on the spot, in a hut provided for that purpose at the airfield.

In accounting for the low death rate of 0.3 percent at this hospital during the first year of its operation due credit must be given to the prompt and efficient first aid administered to wounded men by the medical officers and hospital corpsmen at the front and to the transportation of sick and wounded officers and enlisted men to this hospital by ambulance plane.

B. THE SURGICAL MANAGEMENT OF WAR WOUNDS AT U. S. NAVAL BASE HOSPITAL ———

JOHN M. SCHMOELE
Captain (MC) U. S. N. R.

HARRY R. HUSTON
Commander (MC) U. S. N. R.

EUGENE P. OWEN
Commander (MC) U. S. N. R.

JEROME I. SIMON
Lieutenant Commander (MC) U. S. N. R.

DONALD F. COBURN
Lieutenant (MC) U. S. N. R.

CLARENCE E. GILLESPIE
Lieutenant (MC) U. S. N. R.

and
ELMER RIDGEWAY, JR.
Lieutenant (MC) U. S. N. R.

War casualties, due to land, sea, and air action during the Solomons campaign, were evacuated quickly from the scenes of action to this hospital for their first definitive treatment. They were transported usually by ambulance plane. A small minority were brought by ship. First-aid measures, and in a few instances, emergency surgical treatment, including debridement and amputation, had already been rendered before their evacuation by plane or ship. The majority of patients arrived from 12 to 48 hours after being injured. Despite a 5- to 7-hour airplane trip, often with little or no food and with a limited quantity of fluid for 48 to 72 hours, they arrived generally in good condition.

Most of the severe casualties arrived on the very litter on which they had been placed on the battlefield with the original battle dressings still in place. Clothes and skin still retained the grime, blood, and sweat of battle conditions. Fractures were adequately splinted with half-ringed, hinged army-type splints with a traction hitch over shoe or hand.

Sulfanilamide crystals had been applied to all wounds on the field or at the field hospital. Sulfathiazole had been given by mouth, but sequential dosage had been frequently interrupted by air-raid alarms or sudden transfer or evacuation. All patients had received adequate amounts of intravenous fluids, plasma, or whole blood transfusions, up to the time of evacuation by plane. Additional amounts of fluid were frequently administered intravenously and orally during the airplane

flight. All ambulance planes were met at the airfield by medical officers and hospital corpsmen. If further emergency measures were required, they were performed before the patients were placed in ambulances.

On arrival at the receiving ward, patients were examined immediately and sent to the appropriate wards, usually via the x-ray room. Patients in shock were sent directly to the wards, where suitable measures to combat shock were instituted immediately.

Special wards were established for urological cases, eye, ear, nose, and throat casualties, and for those with burns. Patients with compound fractures, suspected gas bacillus infection, gunshot wounds with foreign bodies in joints, crush injuries with impending gangrene, and those requiring amputations were sent to the orthopedic wards.

Soon after admission patients were classified into the following categories:

Class A—Convalescent expectancy of less than 60 days.

Class C—Convalescent expectancy of over 60 days.

Class D—Permanently disabled for further duty in the South Pacific.

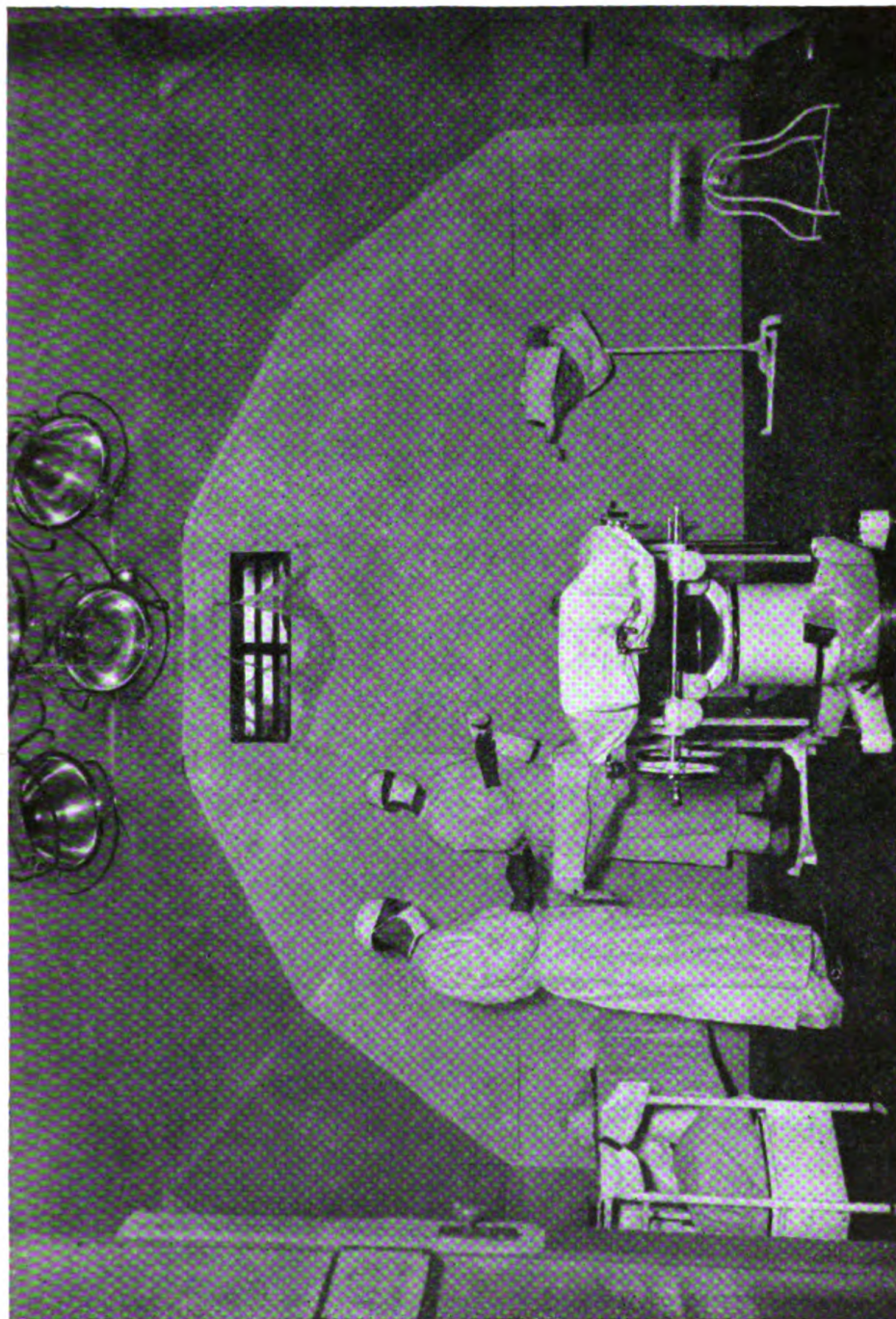
Thus, treatment programs were designed primarily to return as many casualties as possible to duty as soon as practicable. Where this was not feasible, because of the nature of the injury, patients were evacuated by hospital ship or ambulance ship to other facilities for continued treatment and further disposition.

GUNSHOT WOUNDS

Of the hospital admissions from May 4, 1942, to May 4, 1943, 19 percent were for gunshot wounds of all types and for patients with burns. The treatment of these wounds was concerned with three problems: First, debridement; second, removal of foreign bodies; and third, closure.

Debridement.—Wounds from high velocity bullets did not show as much soft tissue destruction as those caused by shell fragments. Small perforating wounds were rarely excised except when they failed to heal due to the presence of small amounts of nonmetallic foreign material.

In the usual shrapnel wound the skin surrounding the wound was thoroughly cleansed with white soap and water. The skin margin surrounding the wound was then removed to a minimum extent. The wound itself was enlarged if necessary to allow free access to deep spaces. All devitalized tissue was removed until healthy, bleeding muscle was encountered, which contracted when pinched by forceps. All foreign bodies and loose fragments of bone were removed, avoiding damage to nerves, tendons, and blood vessels. Fascial planes were opened, as indicated. All bleeding points were ligated. The wound was irrigated with 1:3,300 azochloramid solution, and from 4 to 12 gm. of sulfanilamide crystals were dusted into the wound.



1. One of the operating rooms, U. S. Naval Base Hospital ———.

Foreign bodies.—Ordinarily, before admission to the ward, x-ray examinations had been done and the type and location of the foreign body determined. The most frequently encountered foreign bodies were shrapnel fragments from aerial bombs, projectiles from large naval guns, antiaircraft fire, aerial cannon, land-based artillery, mortar fire, and from hand grenades. Rifle and machine-gun bullets were next in frequency. In addition, secondary missiles such as steel fragments from decks and bulkheads, aluminum fragments from plane bodies, sand and gravel, sticks, wood splinters, paint flakes, caps from detonators, glass, bone, buttons, and metal from helmets, mess gear, and buckles were removed. Dirt, clothing, powder, grass, and other foreign material were also carried into many wounds by the missiles.

While nonmetallic foreign bodies were usually removed during the course of debridement, no hard and fast rule was applied in this regard. Even large fragments located in deep or inaccessible areas may cause no symptoms. Attempts at removal should not be unduly prolonged at the time of primary debridement. If not revealed by careful search during the first debridement valuable information is gained by knowing what to avoid at the second attempt. Fragments of less than three-eighths inch in diameter located in soft tissue do not, as a rule, cause symptoms unless they are close enough to the skin to be palpated or are situated in capsular structures about the joints. In the latter case tension of the capsule on the fragment may cause pain.

All fragments about which infection develops must be removed. In several cases where gas bacillus infection supervened, the metallic fragment could be recognized in the x-ray film as the nidus of the infection. Machine-gun and rifle bullets were not as prone to cause infection as shrapnel.

The removal of foreign bodies has always been a challenge to the operator's technical skill. The development of special locating apparatus has not measurably added to the armamentarium and, furthermore, no such instrument was available to us. While fluoroscopic control is desirable it is not always available. However, preoperative x-rays, films made in two planes, and marking of the site on the skin after fluoroscopic inspection, were important aids. There were other useful points learned from experiences here which are worth mentioning.

The history usually will reveal the nature of the fragment, its approximate direction, the position of the patient at the time of injury, the position of the wounded part, and the velocity of the fragment. Examination of the wound reveals its relation to bony landmarks. Evidence of grooving of the skin before its puncture may be helpful in

determining the direction of penetration. Frequently, direct palpation may reveal a point of tenderness, slight swelling, or induration. Large blebs or bullae on the skin are frequently a clue to the position of superficial fragments which could not be palpated because of swelling.

In the actual search for the foreign body, the wound is first excised. The fascial planes are inspected and palpated. The wound is explored digitally as each layer is entered. A faint thickening or induration barely palpable in a muscle belly may provide the clue to the location of the fragment. The appearance of pus, serum, or old blood may indicate the trail and location of the fragment. Occasionally one may detect a new odor which emanates from the pocket in which the fragment lies. In deep tracts out of reach of the finger, behind a bone shaft or through a small opening in the fascial planes, curved Kelly clamps, or a sponge stick may detect the distinctive metallic click. Thus located, the exposure can be enlarged or a counter incision made. While blind "fishing" with a sponge stick may be rewarded, "fishing" with a toothed clamp is a dangerous procedure.

Closure.—With the exception of gunshot wounds complicated by compound fractures, all soft tissue wounds were closed by delayed primary suture from 2 to 10 days after admission. In some of these cases during the closing days of the campaign, debridement and primary closure were performed on the battlefield, necessarily under adverse conditions. Invariably these wounds were received in an infected, broken-down condition and occasionally with beginning gas bacillus infection. Delayed secondary closure can be performed in the absence of gross infection in soft tissue wounds and thus reduce the healing period and the disability resulting from extensive scarring. Closure must be performed without undue tension. In such cases sutures should not be removed for at least 10 days, since repair is slow.

WOUNDS OF THE CHEST

In general, chest wounds were treated conservatively. This meant absolute bed rest, chemotherapy and nonoperative interference. Debridement and closure of wounds was delayed up to 14 days in some instances. Complete medical and radiological control was available and thoroughly utilized. As a result of this practice patients were evacuated for further disposition with little disability, were afebrile, with closed wounds, and without a single case of empyema.

Patients received with sucking wounds were treated as emergencies. Measures for controlling shock were instituted, and the patients were prepared for surgery after x-ray of the chest had been taken. Debridement of the wound was performed and the wound closed, if

possible. If closure was not possible, the sucking wound was packed with vaseline gauze.

By the time of hospitalization, hemorrhage had usually ceased, and the patient was rarely in shock. If the wound had produced open pneumothorax, debridement was done, the foreign body was removed, if possible, and the wound was closed in layers without drainage. In perforating wounds where fragments of fractured ribs were driven into the pleural cavity or lung, but the wound was not of the sucking variety, surgical treatment was delayed until the patient was in good condition. Later, removal of the rib fragments with secondary closure of the wound was performed. X-ray localization was essential before operation was done for the removal of the foreign body from the lung. The great majority of the patients with perforating wounds recovered without operation.

Aspiration was performed in the following instances: (1) Hemothorax filling the entire pleural cavity on one side; (2) severe respiratory pain; (3) cyanosis; (4) dyspnea; and (5) mediastinal shift. If, however, fever and accelerated pulse did not subside but tended to increase, aspiration was performed for bacteriological examination.

All patients with chest wounds were given large doses of sulfathiazole for the first week after admission, with smaller doses the following week until the temperature remained normal. (For a detailed analysis see the paper in this series by McMahon and Huston.)

ABDOMINAL INJURIES

A small number of patients with abdominal injuries were received at this hospital and still fewer who had been operated upon. The time lapse between injury and admission was too great to expect any favorable result from surgery. These casualties require immediate surgery. A definite rise in mortality after 6 hours takes place and increases in proportion to the time elapsing between injury and operation.

GAS BACILLUS INFECTION

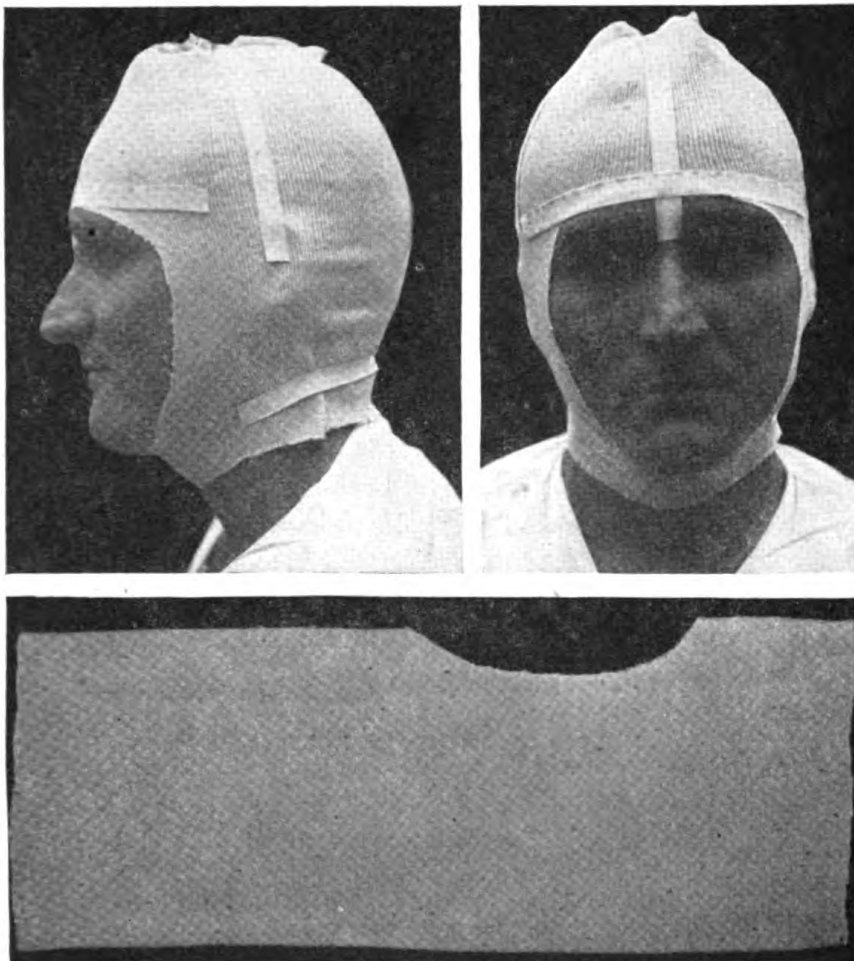
Among the patients with soft tissue wounds 14 developed gas bacillus infection. Nine had minimal clinical signs and 5 had massive infection. In this group 4 deaths occurred, 3 with thigh wounds, and 1 with an abdominal wound. Gas bacillus infection did not develop in any wound on which thorough debridement had been done.

CRANIAL INJURIES

The treatment of compound fractures of the skull necessitated some variation from that generally employed in civil practice. Practically all of these lesions had been sustained from 12 to 48 hours prior to ad-

mission. Almost every wound of this type had been treated with local application of a sulfonamide shortly after it was incurred. An occasional wound had been debrided and closed, but usually the wounds were open, with some herniating cortex tissue presenting.

At first some hesitation was felt in operating upon wounds of over 36 hours' duration; they were treated by the local application of sulfanilamide crystals, sulfadiazine given orally, and repeated spinal punctures. Because of the nature of some of the wounds, however, it



2. Photographs showing pattern (below), and full and profile views of stockinet head dressing in place.

was necessary to debride them thoroughly, and the following routine was adopted in the care of patients with compound skull fractures.

When the patient was admitted to the ward his general condition was appraised. If it was satisfactory, the wounds were dressed, and a decision was made regarding immediate or delayed roentgenologic studies. Sulfanilamide crystals were usually applied to the wound at the time of the initial dressing, and usually a wide area about the wound was shaved and cleansed with ether. Gauze dressings were

applied and held in place by the stockinet type of dressing. A piece of stockinet 6 inches wide and about 14 inches long was used, a crescent-shaped piece being cut out near one end, large enough to make an opening for the face (fig. 2). This was slid over the head with the narrow strip at the bottom serving as a chin strap. The open end at the top was then drawn together with adhesive or a safety pin. The patient was immediately started on a course of sulfadiazine therapy, with an initial dose of 30 gr., followed by 15 gr. every 4 hours. Also, the patient was given at least 3,000 cc. of fluids each 24 hours while taking sulfadiazine. This regime was followed for at least 24 hours before any operative treatment was instituted (except in an emergency).

If the patient was comatose, a small tube was passed through the nose into the stomach, and fluids and medications were given by that route. Barbiturates (nembutal, sodium amytal, and phenobarbital) were utilized for the control of restlessness. Aspirin and its compounds, with or without codeine, was used for control of pain. Occasionally morphine, in $\frac{1}{2}$ -gr. doses, was given for the uncontrolled restlessness and hyperventilation.

Following a study of the x-ray films in the stereoscope, the type of operative procedure to be employed was determined. A detailed description of the operative technic is not in order. Suffice it to say, that with local anesthesia (1 percent procaine) or local anesthesia combined with pentothal sodium given intravenously, a debridement of the wound, including scalp, skull, dura, and cortex (if lacerated) was carried out. Conservatism was necessitated by the lack of hemostatic equipment (silver clips and electrosurgical unit). Hemostasis was obtained by the use of hot saline packs, suction, and muscle clamps. Sulfanilamide crystals were placed in the cortical wound and in the more superficial areas. In view of the duration of the wounds, it was felt that sliding in dura to cover defects might break down protective barriers. The dura was therefore frequently left open. The scalp was closed when at all possible, silk being used when it was available. Sulfadiazine therapy was employed routinely, beginning immediately after operation and continued for a variable period of time. Spinal punctures were done on some patients, although not as a routine procedure. Patients who were not evacuated were kept in bed for from 10 to 21 days.

The absence of meningitis in all of the patients treated here for a compound fracture of the skull has been most encouraging. In spite of grossly contaminated cerebral wounds, the delay in debridement due to transportation from the front, and probable incomplete removal of damaged cortex because of inadequate hemostatic equipment, no meningeal infection was apparent. It is considered that this fortunate situation can be attributed to the early use of sulfonamide

drugs orally and locally, pre- and post-operative sulfadiazine therapy, adequate removal of contaminated tissue, and a relatively high fluid intake.

As regards other types of head injuries, there have been no changes in therapy from those in general use.

It may be of interest to note that three patients who were struck on the head by a falling coconut have been seen. All were badly dazed or knocked unconscious for a short period of time. After 10 to 14 days' hospitalization there were no residual signs or symptoms of cerebral damage. There was no demonstrable skull damage noted in x-ray films.

It has been the practice at this hospital to keep the head of the patient moderately elevated (low Fowler's position), whether he had a mild contusion or a severe compound fracture, provided that his general condition permitted, and that he was not made uncomfortable by such a position. This position is valuable in combating cerebral venous engorgement and edema.

The few cases of subdural hematoma which have been seen were treated by trepanation, with or without additional small decompression. The clot and fluid was washed and sucked out, and the subdural space was drained for 48 hours. A few patients with a large collection of clear fluid in the subdural space were treated by trepanation and drainage.

No cases of extradural hemorrhage were recognized clinically or found at postmortem examination.

We wish to stress again the value of sulfonamide drugs applied topically and orally in the early treatment of compound fractures of the skull in the combat area, and to emphasize the merits of post-operative sulfadiazine therapy, regardless of the interval which has elapsed between injury and operation.

BURNS

Most of the 91 burn casualties admitted to this hospital arrived from 12 to 48 hours after injury in relatively good condition. Forty-two burns were caused by the highly volatile 100-octane aviation gasoline which had been used for various purposes, for example, to start fires in the galley stove or in the burning of trash. Other sources of burns were steam, flash burns, plane crashes, ammunition explosions, and electricity, all occurring at work or during enemy action. Some patients had concurrent fractures and gunshot wounds.

Prior to admission these patients had received morphine, plasma, and fluids and varying types of local treatment. Sulfonamide drugs had been used both topically and orally while debridement had also been performed in several instances. Treatment rendered here was

the first definitive measure after the first-aid and emergency surgical treatment and was both systemic and local.

The extent of skin surface involvement varied from 1 to 90 percent. Of the 91 cases, 24 were minor burns requiring local treatment only. Of the 67 patients with major burns, 15 required plasma, or plasma and supplementary fluids after arrival here. Very few demonstrated the hemoconcentration one may expect early in a severe burn. Only 4 had hemoglobin values of 100, with 5 million or more red blood cells. These cases usually had correspondingly high white counts, varying from 15,000 to 35,000. A not infrequent finding, however, was a relative leukopenia. In 14 instances urinalysis revealed albumin and casts but no associated clinical manifestations of kidney dysfunction. Anemia occurred in one fatal case.

Two deaths occurred in patients with almost complete body burns. Both arrived at the hospital in a moribund state. One lived 12 hours, the other 4 hours. Both failed to respond to prompt supportive treatment. In the first case the extent of surface area involved by the burn made it necessary to expose the great saphenous vein for the administration of fluids. Since then, the intrasternal route has been utilized for fluid administration in such cases.

Systemic treatment.—Supportive treatment in the form of plasma and fluids was administered whenever indicated. In the 15 cases in which this was found necessary the indications were vomiting, high hematocrit determinations, increased blood concentration, or high fever. Those who could take fluids by mouth had fluids of high caloric value forced upon them. It was gratifying to receive the cooperation of patients in taking from 4,000 to 5,000 cc. of fluids orally each day.

The patient was placed on sulfathiazole orally on admission, in a dosage of 1 gm. every 4 hours for 3 days. In only one instance was sensitivity to the drug observed, manifested by vomiting and rise in temperature. These symptoms subsided rapidly upon withdrawal of the drug and the use of sulfathiazole ointment. The burn, a minor one of the leg, healed rapidly with the application of unmedicated white vaseline locally.

Local treatment.—The type of local treatment employed depended upon the elapsed time between the injury and admission to the hospital. If less than 24 hours had elapsed the wounds were regarded as clean. Those exceeding this time interval were regarded as infected.

The local treatment of clean cases consisted of (1) debridement of the burn area, under anesthesia if necessary; (2) application of crystalline sulfathiazole powder which was sprayed with an ordinary nasal atomizer; (3) covering the area with a thin layer of tannic acid jelly; and (4) placing the part under a heat cradle. The latter caused the jelly to crust more rapidly and provided warmth for the patient.

Many patients suffering from extensive involvement of skin surface complained of feeling cold.

This method was used on the face and over joints as well as on other parts of the body. With this procedure the thin crust of the tannic acid-sulfathiazole powder eschar was flexible and did not restrict joint motion (fig. 3). A thick tannic acid crust acts much as a splint, causing limited motion and impeding recovery. The early use of the tannic acid-sulfathiazole powder crust prevented some fluid loss. As the underlying skin regenerated, the crust loosened, and began to flake off much like the desquamation of sunburned skin.



3. Application of tannic acid and crystalline sulfathiazole powder to second- and third-degree burns of trunk and extremities. Lightness and flexibility of eschar prevents serious limitation of range of joint motion.

Infected cases.—In cases received after 24 to 36 hours from the time of the burn, secondary infection was invariably present. These patients were immersed in full body length saline baths several times a day to wash away purulent material and epithelial debris. Between baths they were covered with 5 percent sulfathiazole ointment applied to the burn areas with a wooden tongue blade (fig. 4). The ointment was prepared with a white vaseline base. No dressings were used, the patient being entirely exposed to the air, permitting open drainage. By avoiding the use of surgical dressings new epithelial formation was protected from repeated trauma. The daily improvement in these cases as new epithelium developed was remarkable. The skin became clear and pliable as the infection disappeared. The patients were comfortable and had complete freedom of movement.

Comment.—The excellent quality of the primary treatment in the field was responsible for the arrival of these patients in relatively good condition. Blood plasma was used early and sulfonamides were employed topically and orally. The employment of debridement, sulfathiazole powder combined with tannic acid jelly in the clean cases and the use of saline baths and sulfathiazole ointment in the infected cases provided a simple and effective method of treatment.



4. Second- and third-degree burns of back and forearms treated with sulfathiazole ointment. Absence of dressings simplified treatment, was more comfortable to patient, and less complicated by infection.

ANESTHESIA

The choice of an anesthetic in war surgery depends not only upon available supplies but also, because of the location of the hospital, upon local climatic conditions as well. The excessive saturation of the air with moisture made the use of time-honored anesthetic agents, such as open drip ether, impractical at this tropical station. Apparatus for the use of volatile gases, such as ethylene, nitrous oxide, and cyclopropane in a closed system, was not available.

Of 1,645 anesthetics administered, open-drip ether was used 24 times. Its use was abandoned since vaporization was so slow that it was difficult to anesthetize the patient or to secure and to maintain adequate surgical relaxation.

Local procaine anesthesia (1 percent solution, with regional block) was used in 604 instances and applied in the usual manner without producing any unusual local or systemic reaction.

Spinal anesthesia (procaine) was used in 572 instances. It was the choice in all elective abdominal cases, abdominal casualties not in shock, and prolonged operations on the lower extremities when the patient was in good condition. Ephedrine sulfate was used to maintain blood pressure.

Sodium pentothal anesthesia.—The most satisfactory anesthetic agent employed was sodium pentothal. Its use in 445 cases proved it to be the best all-purpose anesthetic agent. Its use obviated the need for gaseous agents. In practically every type of surgery including craniotomies, maxillofacial surgery, plastic repair of the eye and eyelids, it proved to be a safe and effective anesthetic agent. It was not the agent of choice when surgical relaxation of the abdomen was desired. In chest surgery, however, it was employed exclusively without any ill effect. It was occasionally used in the extraction of teeth and was also valuable as a supplement to spinal anesthesia when the latter became no longer effective.

In extensive debridements and in emergency amputations, particularly of the lower limbs, it was preferred to spinal anesthesia in patients who were in shock or who were otherwise poor risks. Multiple operative procedures were frequently performed satisfactorily despite extensive injuries. In one instance, these procedures included amputation of both forearms, resection of one testicle and debridement of the perineum, debridement of both thighs with removal of foreign bodies, removal of a large piece of shrapnel from the jaw and face, with repair of the jaw wound and wiring of the jaw.

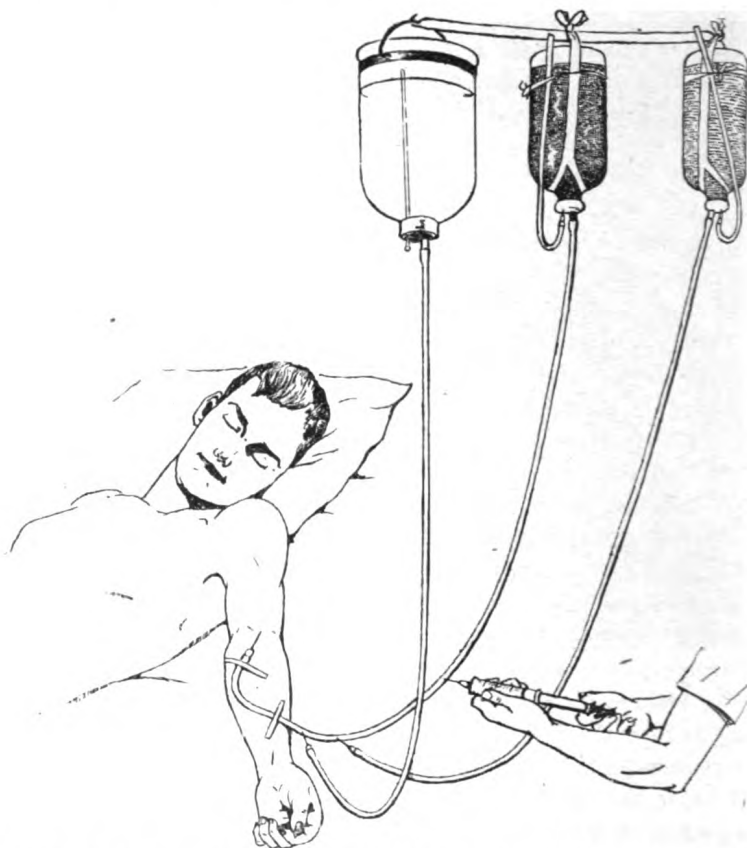
Patients in poor condition tolerated pentothal sodium well, even when the operation lasted for more than 1½ hours. In such patients, 5 percent dextrose in normal saline solution was administered intravenously before the pentothal sodium was injected. The latter was then introduced into the tubing carrying the dextrose solution. If the patient was in shock, plasma or blood or both were introduced into the original infusion tubing without ill effects (fig. 5). Anesthesia by this method has been adequately maintained for 3 hours in patients in good general condition.

There has been only one case of apparent respiratory paralysis, this being temporary and responding rapidly to the usual methods of resuscitation. It was attributed to the injection of an excessive dose.

Technic.—Adequate preoperative medication was essential. Phenobarbital, gr. 1½, was administered the preceding night. Two hours before operation, nembutal, gr. 3, was administered. One hour before operation, morphine sulfate, gr. ¼, together with atropine sulfate,

gr. 1/150, was given. It was important to delay the administration of the pentothal sodium until a full hour had elapsed. If the morphine was administered immediately before operation its maximal depressing effect would coincide with that of the pentothal sodium, thus causing marked depression of respiration.

The drug was prepared in 2½ and in 5 percent solution and was injected slowly into an antecubital vein. To each 20 cc. of solution one ampule of coramine was added. Precaution against respiratory ac-



5. Pentothal sodium, plasma, whole blood, and 5 percent dextrose in saline administered concurrently.

cidents was taken by having available an airway, carbon dioxide, oxygen, and other respiratory stimulants. Induction occurred quite rapidly (within 15 to 20 seconds) and anesthesia was maintained by continued administration of small amounts. Recovery was rapid or prolonged depending upon the amount of the drug used and individual variation in response. The amounts used ranged from ½ gm. to as much as 4 gm. in occasional cases. In the latter instances the patient

slept for many hours following the operation, but in no instance was recovery followed by nausea or vomiting.

Comment.—Pentothal sodium was found to be an ideal anesthetic agent because of its wide applicability. It was especially valuable because climatic conditions prevented the satisfactory use of ether. The drug does not require a trained anesthetist although it must be used with caution. At this station every medical officer has administered it. The drug is readily available, is easily mixed, is nonexplosive and noninflammable. It is practical for use afloat and ashore. The drug is rapidly metabolized. Sulfonamide drugs may be used concomitantly. Skin sloughs or thromboses are uncommon with the use of the 5 percent solution. It is pertinent to observe that the patients treated at this hospital were generally in the lower age group.



THEORY AND THERAPY OF SHOCK

Clarity may be gained by abandoning the term "primary" shock and replacing it with syncope, vasomotor collapse or any other expression that can be accurately defined. The single word, shock, will be used to denote the condition formerly called "secondary" shock.

Suboxidation and increased capillary permeability (locally or systematically) dominate the picture of shock from beginning to end, and lead to death by anoxia. The process which draws water and electrolytes into the tissue spaces from the blood and possibly also from the cells may be attributed to three possible causes, namely, an increased avidity of the tissues, a vital alteration in the capillary endothelium, or a shift of osmotic balance due to metabolic products either of the original injury or of suboxidation.

Local refrigeration, which was formerly found effective for preventing shock, is also helpful in the treatment of shock originating from the limbs and presumably other bodily areas which can be efficiently chilled. The survival of shocked dogs is lengthened by simple refrigeration of the injured legs, and still more by prolonged or intermittent tourniquet application with refrigeration.

The essential therapeutic effect of these measures is a retardation of the shock process, affording a greatly lengthened time for other treatment and better ability to respond to it. Within limits, the lengthened survival can be converted into permanent recovery by the simple administration of fluids by stomach or salt solution subcutaneously.—Allen, F. M.: Theory and therapy of shock; reduced temperatures in shock treatment. *Am. J. Surg.* 60:335-348, June 1943.

C. ACTIVITIES OF THE ORTHOPEDIC DEPARTMENT AT U. S. NAVAL BASE HOSPITAL ———

HENRY H. KESSLER
Commander (MC) U. S. N. R.

JEROME HARTMAN
Commander (MC) U. S. N. R.

CHARLES B. BEYMER
Lieutenant Commander (MC) U. S. N. R.

MANLEY B. SHAW
Lieutenant (MC) U. S. N. R.

and
MARVIN C. BECKER
Lieutenant (MC) U. S. N. R.

Of the war casualties admitted to this hospital, patients with compound fractures of the extremities, gas bacillus infection, gunshot wounds with foreign bodies in joints, crush injuries with impending gangrene, and amputations were allocated to the orthopedic wards. These casualties were in the main so severe that the fundamental hope of returning them to duty could not be realized. Nevertheless our responsibilities were nonetheless clear; to save lives, to preserve limbs, and to maintain function.

COMPOUND FRACTURES

On arrival at the orthopedic ward a history was taken and physical examination was done and the wounds were dressed. If secondary shock supervened, dextrose, plasma or whole blood were given as indicated. If immediate surgery was not necessary the patient was given a bath. Hot soup and chocolate were given to all in condition to take it. Administration of sulfathiazole, grains 10 every 4 hours, was begun and morphine was given to relieve pain. *All patients with large wounds, foul-smelling wounds, or elevated temperatures were taken to surgery within 4 hours after admission.*

Femur.—On admission to the ward the traction hitch on the Army splint was removed while manual traction was maintained until the wounds were dressed. If debridement was not indicated (small perforating wounds) a Kirschner wire or Steinmann pin was introduced through either the femoral or tibial condyles. Balanced traction was then instituted by suspending the extremity in a Thomas or half-ring splint with a Pearson attachment to secure knee flexion. Slings were applied so that dressings could be changed with a minimum disturbance to bone alignment.

If debridement was indicated the patient was removed to the operating room in his original splint. There the splint was removed and manual traction maintained while the skin was shaved, scrubbed and prepared for debridement. The skeletal pin was first inserted after induction of pentothal sodium anesthesia. Debridement consisted in excising no more than $\frac{1}{4}$ to $\frac{3}{8}$ inch of healthy skin margin, but all devitalized tissue was widely excised, including all foreign material and free bone fragments. Bleeding was controlled by hot sponges and ligature followed by irrigation with 1,000 cc. of warm saline or 1:3,300 azochloramid solution. Our aim was to obtain a sloping wound, at the bottom of which one could see the fracture site. All raw surfaces were then dusted with crystalline sulfanilamide and the wound gently filled (not packed) with strips of vaseline gauze. Small dry dressings were then applied and the limb immobilized with heavy molded anterior and posterior splints. Circular casts were found not suitable for primary fixation because of swelling and profuse drainage, especially from the larger wounds. After debridement and insertion of vaseline gauze the splint was reapplied for transportation back to the ward where balanced traction was set up. Traction was maintained until x-ray and palpation revealed sufficient callus to warrant casting. Casts were applied in bed by use of a spica box, maintaining skeletal traction until the plaster had set.

Tibia and fibula.—In the leg many large avulsed wounds were encountered as a result of a high velocity missile striking the bone, converting these fragments into secondary missiles. Reduction of these fractures (lacking a fracture table) was accomplished by simple manual traction and countertraction. After the surgical treatment of the wound, an unpadded, wide, heavy anterior plaster splint was molded over the whole lower extremity until it had set firmly, molding it well around the thigh and calf so that more than half the circumference was enclosed. Slight knee flexion was obtained by a folded towel under the knee while traction, proper rotation, and alinement was maintained by an assistant. The traction was maintained while a narrow posterior splint was applied and secured by a circular gauze or plaster bandage.

Tarsus.—Fractures of the tarsus were particularly troublesome because of the marked swelling which occurred even after debridement and splinting. Fever took longer to subside in this group, perhaps because of the multiple joint surfaces that were involved. Only posterior molded splints were used as a primary fixation so that swelling could easily be controlled. After the circular cast was applied a walking iron was incorporated if the avulsion of soft tissues was not too great.

Pelvis.—Only one compound fracture of the pelvis, which required a double hip spica, was encountered.

Humerus.—Hanging casts gave satisfactory position and control due to the absence of deforming muscle pull associated with gunshot wounds. A shoulder spica was used in only a few instances. With the hanging cast, patients were ambulatory within a few days. Proper extension of the cast was used to prevent deformity and stretching in cases of associated peripheral nerve lesions. Skeletal traction was applied in only one case (fig. 1).



1. Compound fracture of the humerus treated by hanging cast.

Radius, ulna, and carpus.—Fractures in these bones presented no problems in maintaining reduction. As in leg fractures anterior and posterior splints were used, to be replaced by a circular unpadded cast when profuse drainage had ceased. Skeletal traction was used in only one instance. Many of the wounds were complicated by tendon and nerve lesions but no primary repairs were attempted. Several had such severe avulsion that later amputation seemed inevitable.

Fractures of the carpus were all immobilized in position of optimum function should ankylosis occur.

Metacarpals, metatarsals, and phalanges.—For the simpler fractures in these bones the usual splints and dressings were employed. Skeletal traction through the terminal phalanx was found to be the satisfactory method for severe fractures with avulsion or displacement. Safety pins bent to the form of a closed horseshoe were used as pins, and the casts for the wire bow countertraction ran to the knee in the lower extremity and the elbow in the upper. This allowed close inspection of the circulation, position, and wound.

TABLE 1.—Incidence of fractures

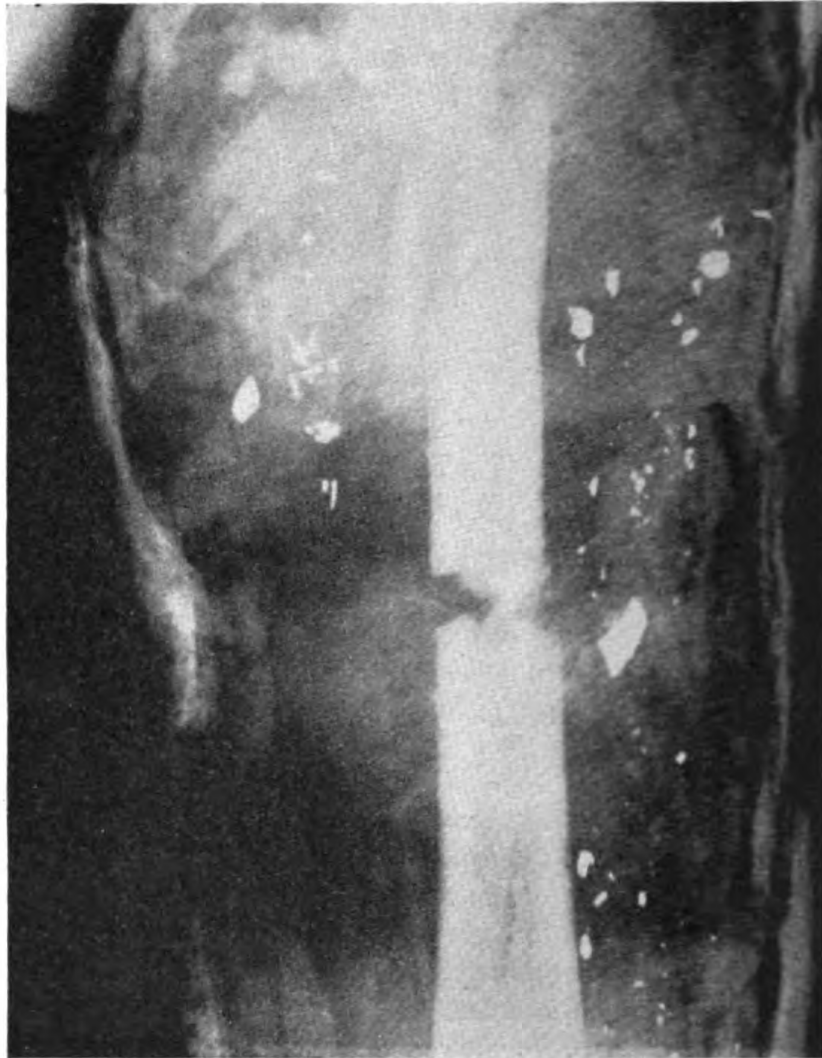
Total number of patients with com-	Carpals.....	22
pound fractures.....	470 Metacarpals.....	49
Multiple fractures.....	132 Phalanges (hand).....	57
Total number of fractures.....	722 Femur.....	62
Clavicle.....	11 Tibia.....	66
Ribs.....	50 Fibula.....	41
Vertebrae.....	8 Patella.....	8
Scapula.....	23 Tarsals.....	43
Pelvis.....	23 Metatarsals.....	69
Humerus.....	48 Phalanges (foot).....	62
Radius.....	43 Ulna.....	37

Summary.—Four hundred and seventy casualties with 722 compound fractures were treated. There were 9 deaths. One required amputation (see section on amputation for gas bacillus infection) and there were 3 cases of osteomyelitis. The possibility of osteomyelitis developing later must be considered, although many of the patients were under observation for 3 months and were afebrile when discharged.

The most striking observation in this series was the almost uniformly good position of fractured fragments. Many of the fractures were massive, extremely comminuted with gross avulsions of portions of the bone. The excellent position of fragments is attributed first, to the excellent battlefield splinting, and secondly, to a definite loss of muscle tone amounting almost to a paralysis of the muscles. As a result the usual deformities due to muscle pull were lacking (fig. 2). We attributed this phenomenon to the terrific impact of high velocity bullets and shrapnel fragments. Further studies of the nature and causation of this condition would be valuable.

The second unusual feature was the rapid subsidence of fever with the regime outlined before. Patients admitted with massive multiple wounds containing necrotic, malodorous muscle and filled with loose bone and metallic fragments would become afebrile within 48 hours after debridement and immobilization. Thus, our primary objective

which was to get them in condition for further prolonged transportation by evacuation ship, could be realized. To do this the wounds had to be clean, the patients afebrile, and the fracture held by a plaster dressing that provided firm immobilization and permitted transportation readily on a Stokes stretcher or a standard Army litter. Operative procedures and cast changes could thus be held to a minimum aboard the hospital or ambulance ship.



2. Multiple fractures of femur due to shrapnel wounds. Good alignment due to muscle paresis (phenomenon of "stupeur musculaire").

MANAGEMENT OF JOINT WOUNDS

Open wounds into joints varied from pin-point entrance wounds to almost complete avulsion of the articulation. Small puncture wounds or lacerated wounds with clean-cut edges were not debrided. These were dusted with sulfanilamide powder and immobilized by a plaster splint and pressure dressing. Effusions into joints were not aspirated

unless the temperature was elevated. If there were small particles (up to one-fourth inch in diameter) in the joint, accompanied by elevated temperature and effusion, or hemorrhage, the joint was aspirated and



3. Compound fracture of the elbow joint with numerous shrapnel fragments. Only large and accessible fragments removed. Smaller ones removed during debridement of wound.

the contents of an ampule of crystalline sulfanilamide suspended in normal saline solution were injected. With rest by splinting, the effusion and temperature subsided. It was not necessary to explore for these smaller particles (fig. 3).

Particles larger than one-fourth inch in diameter usually required removal. The entire joint area was prepared, and with the entrance wound draped out of the field the foreign body was removed through a separate incision. The joint was irrigated with normal saline solution and sulfanilamide crystals were sprinkled in the joint. The clean wound was closed in layers and covered. The entrance wound was then debrided, frosted with sulfanilamide crystals, filled with vaseline gauze, and the limb splinted by plaster. Fall of temperature to normal followed in 3 to 4 days.

Large avulsing wounds of joints were treated by thorough debridement of bone and soft tissues. The cavities were frosted with sulfanilamide crystals, filled with vaseline gauze and immobilized in plaster splints. The temperature remained elevated in these cases from 7 to 10 days. Extremely high fever (104° to 105° F.), such as is frequently seen in pyarthrosis of septic origin, was not observed. After the temperature and profuse drainage subsided a circular cast was applied. The wounds were redressed loosely under aseptic technique.

Shrapnel wounds proved most likely to become infected. Wounds produced by saber, bayonet, or by rifle and machine-gun bullets only occasionally became infected. Joints containing shrapnel fragments larger than three-fourths of an inch were treated by immediate surgical measures if the temperature was elevated. Fragments of shrapnel which had traversed the joint and had become imbedded in bone had to be removed. Removal of rifle and machine-gun bullets was optional since they could usually be left without danger.

Compound fractures in joints, when the joint surface was not exposed in the wound, showed no tendency to become infected even though the joint was distended with blood and synovial fluid. Treatment consisted of immobilization along with reduction of the fracture. Care was taken to immobilize the joints in position of maximum function in the event of ankylosis.

GAS BACILLUS INFECTION

Thirty-six cases of gas bacillus infection were treated at this hospital. This includes both clinical gas gangrene and wounds with positive cultures but with minimum clinical evidence of the infection. All patients had gunshot wounds, 17 being in the foot or leg (fig. 4), 12 in the thigh, 1 in the abdomen, 3 in the hand and forearm, and 9 in the arm. (See tables 2 and 3.)

TABLE 2.—Cases of gas gangrene

Age	Wound	Part of body	Cul. x for clostridium	Serum, 1,000 units	x Cul. No gas clinically	Gas gangrene	Vascular gangrene	Transfusions	Sulfathiazole, grams	Sulfanilamide in wound	X-ray therapy	Sulfathiazole I. V.	Fractures, compound	Gas crepitus	Gas bubbling in wound	X-ray evidence of gas	Amputation	Complications	Debridement only	Metallic foreign body in wound	Mousy odor	Discoloration of skin	Swelling	Temperature at onset	Plasma (units)	W.B.C.	Result
20	Shrapnel	Leg	x	80	0	x	x	1	51	x	0	0	0	0	x	x	x	x	RA-0	0	0	x	x	102	0	19,000	Evacuated.
19	do	Arm	x	110	0	x	0	2	85	x	0	0	0	0	x	x	x	0	OS	x	0	x	102	0	21,000	Do.	
25	Gun-shot wound	Leg	x	100	0	x	x	6	28	x	0	0	0	0	x	x	x	x	MA	0	0	x	103	0	19,200	Do.	
18	do	do	x	60	0	x	x	3	150	x	0	0	0	0	x	x	x	x	RA	0	0	x	103	1	16,600	Do.	
24	Shrapnel	do	x	110	0	x	0	2	85	x	0	0	0	0	x	x	x	x	0	0	0	x	103	2	24,300	Do.	
22	Gun-shot wound	do	x	160	0	x	x	1	9	x	0	0	0	0	x	x	x	x	0	0	0	x	103	2	16,600	Died.	
19	Shrapnel	do	x	200	0	x	0	4	x	x	0	0	0	0	x	x	x	x	0	0	0	x	102	1	24,300	Evacuated.	
22	do	Hand	x	80	0	x	0	0	56	x	0	0	0	0	x	x	x	0	0	0	0	x	103	0	11,500	Do.	
21	Machine gun	Thigh	x	140	0	x	0	2	160	x	0	0	0	0	x	x	x	x	P	x	0	x	102	0	12,600	Do.	
23	Shrapnel	Leg	x	120	0	x	0	2	54	x	0	1	0	0	x	x	x	x	RA	0	0	x	105	2	18,600	Do.	
21	do	Abdo- men	x	40	0	x	0	2	0	x	0	0	0	0	x	x	x	0	0	x	0	x	---	0	31,000	Died.	
20	do	Leg	x	110	0	x	0	8	42	x	0	0	0	0	x	x	x	x	MS	0	x	x	103	0	15,600	Died of septicæmia. ¹	
21	Machine gun	Thigh	x	120	0	x	x	2	20	x	0	0	0	0	x	x	x	0	0	x	x	x	103	1	15,600	Died.	
21	Shrapnel	do	x	100	0	x	x	4	45	x	0	0	0	0	x	x	x	x	B	0	x	x	102	2	13,050	Do.	
23	do	Leg	x	100	0	x	0	4	48	x	0	0	0	0	x	x	x	x	E	0	x	x	103	3	20,000	Died of exhaustion from multiple wounds.	

I—Ice anesthesia.
P—Pyarthrosis hip.

B—Bilateral infection of thighs.
A—Aneurysm.
RA—Reamputation.

OS—Osteomyelitis.
S—Septicæmia.
M—Malaria.

¹ This patient recovered from the gas bacillus infection, to die of streptococcal septicæmia six weeks later.

TABLE 3.—Cases of gas bacillus infection with minimal clinical signs

Age	Wound	Part of body	Cul. x for clostridium	Serum for 1,000 units	x Cul. No gas clinically	Gas gangrene	Vascular gangrene	Transfusions	Plasma	Sulfathiazole, grams	Sulfanilamide in wounds	X-ray therapy	Sulfathiazole I. V.	Fractures, compound	Gas crepitus	Gas bubbling in wound	X-ray evidence of gas	Amputation	Complications	Debridement only	Metallic foreign body in wound	Mousy odor	Discoloration of skin	Swelling	Temperature at onset	W. B. C.	Result
18	Machine gun.	Leg.	x	20	x	0	0	1	0	67	x	0	0	0	0	x	x	x	RA	x	x	0	0	0	102	12,800	Evacuated.
21	Shrapnel	do.	x	40	x	0	0	0	0	50	x	0	0	0	0	x	x	x	SG	0	x	0	0	0	104	25,900	Do.
20	Gunshot	Thigh	x	30	0	0	0	0	0	26	x	0	0	0	0	x	x	x	0	0	x	0	0	0	103	20,150	Do.
21	Machine gun.	Leg.	0	0	0	0	0	0	0	87	x	0	0	0	0	0	0	0	0	0	0	0	0	0	100	7,400	Do.
32	Shrapnel	Arm.	x	60	x	0	0	4	1	100	x	0	0	0	0	0	0	0	0	0	0	0	0	0	102	18,200	Do.
25	do	Thigh	x	80	x	0	0	2	1	138	x	0	0	0	0	0	0	0	0	0	0	0	0	0	102	16,500	Do.
25	do	Leg.	x	70	x	0	0	0	0	x	x	0	0	0	0	0	0	0	0	0	0	0	0	0	103	6,400	Do.
20	do	Thigh.	x	25	x	0	0	0	0	22	x	0	0	0	0	0	0	0	0	0	0	0	0	0	102	13,050	Do.
20	Machine gun.	do.	x	80	x	0	0	0	0	51	x	0	0	0	0	0	0	0	0	0	0	0	0	0	103	13,000	Do.
18	do	Leg.	x	30	x	0	0	0	0	27	x	0	0	0	0	0	0	0	0	0	0	0	0	0	105	6,750	Do.
25	Gunshot.	Arm.	x	20	x	0	0	0	0	8	x	0	0	0	0	0	0	0	0	0	0	0	0	0	99.6	17,700	Do.
20	Machine gun.	Thigh	x	40	0	0	0	0	0	0	x	0	0	0	0	0	0	0	0	0	0	0	0	0	98	13,600	Do.
18	do	do	0	0	0	0	0	0	0	0	x	0	0	0	0	0	0	0	0	0	0	0	0	0	102	12,700	Do.
23	Shrapnel	Leg.	x	0	x	0	0	0	0	32	x	0	0	0	0	0	0	0	0	0	0	0	0	0	100	28,100	Do.
36	do	Thigh.	x	0	x	0	0	4	0	40	x	0	0	0	0	0	0	0	0	0	0	0	0	0	101	7,300	Do.
19	Gunshot.	Arm.	x	0	x	0	0	0	0	8	x	0	0	0	0	0	0	0	0	0	0	0	0	0	99	10,200	Do. ¹
45	Shrapnel	Leg.	x	0	x	0	0	3	0	48	x	0	0	0	0	0	0	0	0	0	0	0	0	0	101	9,400	Do.
25	do	Thigh	x	0	x	0	0	0	0	16	x	0	0	0	0	0	0	0	0	0	0	0	0	0	101	21,400	Do.
31	do	Arm.	x	0	x	0	0	0	1	28	x	0	0	0	0	0	0	0	0	0	0	0	0	0	101	12,800	Do.
24	do	Thigh.	x	0	x	0	0	2	4	57	x	0	0	0	0	0	0	0	0	0	0	0	0	0	101	19,850	Do.

AD—Abdominal distention, severe transfusion reaction.

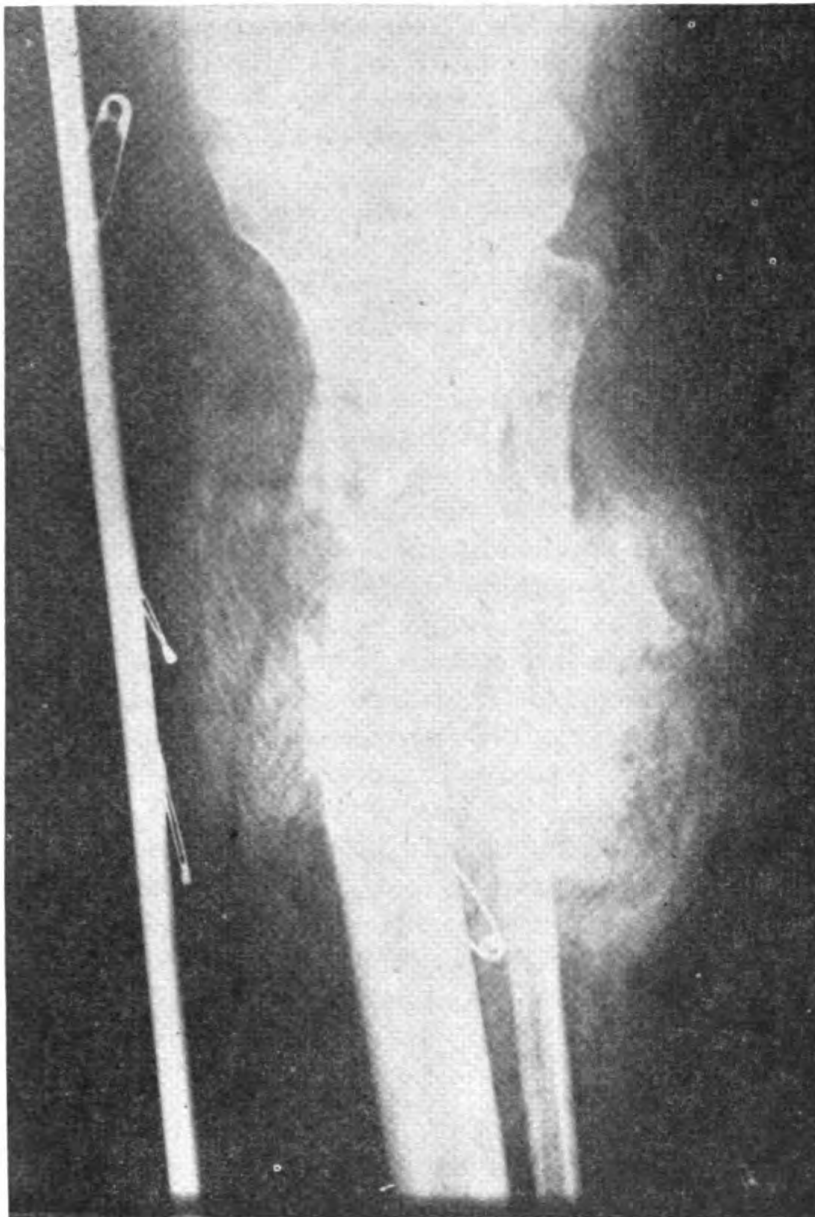
RA—Reamputation.

SG—Skin graft.

OS—Osteomyelitis.

¹ This patient developed gas gangrene aboard evacuation ship; arm was amputated and patient died.

All wounds had been dusted with sulfanilamide in the field and most of the patients had received sulfathiazole by mouth, although because of battle conditions this was irregular and interrupted. All fractures were received well splinted.



4. Compound fracture of tibia and fibula with gas bacillus infection. Gas shadows can be seen infiltrating muscle planes.

Thirty-four cases, or 94 percent of the total number, had the infection on admission or developed suggestive signs before debridement could be done. One patient developed gas bacillus infection after a debridement which was known to be incomplete, but which could not be completed because of massive thigh wounds and shock. Gas ba-

cillus infection occurred in no instance in which thorough debridement was done.

There were 1,650 admissions for gunshot wounds with an incidence of 2.18 percent of gas bacillus infection. Five deaths occurred in this group, giving a mortality rate of 13.9 percent. Three deaths occurred in patients with thigh wound infections, one in a leg wound infection and one in an abdominal wound infection.

The causative organism was found to be of the *Clostridium* group in all cases cultured, but laboratory facilities for further differentiation were not available.

Treatment.—Since patients arrived from 12 to 48 hours after injury, prophylactic serum was not administered. Gas bacillus infection was manifest clinically on arrival or developed characteristic signs so promptly thereafter that it was suspected to have been present on admission.

Suspected cases and frank clinical cases received large therapeutic doses of gas gangrene combined antitoxin. (See tables 2 and 3.) Immediate and thorough debridement was carried out on cases in which gangrene was not present. Amputation was performed at once on all cases of gas bacillus infection with thrombosis of the artery and gangrene. All wounds were dusted with sulfanilamide crystals at operation and filled with vaseline gauze. Amputation stumps were left open. Oral sulfathiazole therapy was carried out, and plasma and blood transfusions and fluids were given intravenously as indicated. In five cases x-ray therapy was employed. A small portable diagnostic machine was used with a dosage estimated to deliver 75 r.

Comment.—Because in all cases sulfonamides and combined antitoxin serum were used, the individual efficiency of either agent cannot be evaluated. X-ray therapy was used empirically. Sulfanilamide crystals in the wounds, sulfathiazole by mouth, and adequate splinting combined with thorough debridement appear to have lessened the factors which favor the development of gas bacillus infection.

AMPUTATIONS

Among the casualties brought to this hospital for treatment and later evacuated, patients requiring amputation comprised a small but important group. Up to June 1, 1943, 39 major amputations were performed. There were 16 in the upper extremity and 23 in the lower extremity. The majority of the amputations were done for gunshot wounds causing irreparable injury to the main blood vessels, rapidly spreading gas gangrene, or extensive loss and destruction of tissue. Of the 39 cases, 10 flap and 29 guillotine amputations were performed. Three flap amputations broke down requiring reamputation. Refrigeration anesthesia was employed successfully in 1 case.

The responsibility of the surgeon in amputations is twofold. He is concerned not only with the removal of the gangrenous, infected or mutilated limb, but also with the task of fashioning a stump by means of which a suitable prosthesis can be worn. The rehabilitation of the amputee depends, in a large measure, on this prosthesis because it reduces the public prejudice toward his defect and increases his potentialities for occupational fitness.

End bearing prosthesis.—The surgery of leg amputations has, therefore, been largely conditioned by the problem of prosthesis. For example, before artificial limbs reached their present state of perfection, most limbs were of the peg leg variety. Support was carried on the end of the amputation stump, or in the case of short lower leg, on stumps on the flexed knee. Largely influenced by this tradition, amputations have been so performed as to secure adequate end bearing stumps. This meant that terminal scars were avoided and adequate padding of the stump provided. There arose then the necessity for making unequal skin flaps. Padding of the stump was secured by utilizing large muscle flaps to cover the end of the bone. This idea was later carried a step further by providing bony covering, with the patella covering the end of the femur, in the Gritti-Stokes amputation, and the os calcis covering the tibia in the Pirogoff amputation.

Side bearing prosthesis.—The old tradition of the peg leg and end bearing has given way to the production of artificial limbs which owe their value to the support provided by the lateral surface of the stump supplemented by special pressure bearing areas. In the lower leg, these areas are the tibial tubercle, the internal condyle, and the head of the fibula. In the thigh the ischium supplements the support obtained from the entire circumference of the thigh stump.

With a side bearing prosthesis there is no fear of terminal scars. Equal flaps or a circular skin incision may be made with impunity. Since padding for the end of the stump is not required, muscle flaps are unnecessary. Moreover, muscle is not biologically adapted for pressure bearing. If it is snugly prepared it quickly degenerates into a fibrous mass. If redundant, it becomes pinched between the stump and the limb socket producing pressure sores. It is sufficient to cover the bone snugly with subcutaneous fascia and skin, thus avoiding redundancy.

In very tall individuals, however, end bearing stumps provide better balance. In double leg amputations where one or both amputations will be above the knee, end bearing stumps are of value. Among primitive people who have never worn shoes, a Syme or Pirogoff amputation is of decided advantage in affording weight bearing without a prosthesis. The same applies to the person who must get up at night to go to the bathroom.

Site of amputation.—Frequently the surgeon has no choice in selecting the site of amputation because of the nature or location of the gunshot wound. Occasionally he may make such a selection. Certain classical sites have been designed by custom. These sites are essentially arbitrary and are conditioned largely by the requirements of limb wearing. They represent the optimum mechanical conditions as to bone length and muscle action for the support and leverage necessary to utilize a prosthesis. Accordingly, too long a stump may be just as inadequate as too short a stump whether above or below the knee. Again the type of prosthesis influences the surgery.

Partial foot amputations of the classical Lisfranc or Chopart type are unsatisfactory because of the loss of leverage behind the tarso-metatarsal joints. A Syme amputation is a decidedly better procedure, although its full value will depend upon a properly constructed limb. Its disadvantage is the weight of the limb and its bulkiness at the ankle. The Pirogoff amputation is performed only in exceptional circumstances. The optimum site in the lower leg is the point 7 inches below the internal condyle of the tibia. This point can be easily determined by crossing the affected leg on the sound one, when the groove between the tibial and femoral condyles becomes quite pronounced and provides simple access to the measuring point. The minimum amount is 3 inches below the internal condyle. Any shorter stump causes loss of the attachments of the hamstrings.

The classic site in the thigh is still the junction of the lower and length of bone. The Gritti-Stokes operation is more satisfactory if end bearing is desired. One of the neglected amputations is that of disarticulation of the knee. The articular surface of the condyle of the femur is biologically fitted for weight bearing as is the skin over the patella. The broad base of the flared condyles provides good support.

The classic site in the thigh is still the junction of the lower and middle third. The shortest stump practical is one 3 inches below the greater trochanter. Disarticulation of the hip is practicable and a satisfactory artificial limb can be worn.

Flap amputations.—In flap amputations the classical sites of election should be given careful attention. However, routine flap amputations are undesirable in war surgery. They should never be done in the presence of massive infection, particularly gas bacillus infection. In three instances in which this type of amputation was performed elsewhere, the flaps broke down because this rule was not observed. In selected cases, however, especially with the added weapon of sulfanilamide, the risk is not so great. In two instances, perforating gunshot wounds of the thigh caused uncontrollable hemorrhage, necessitating high ligation of the femoral artery. Gangrene supervened but the absence of infection permitted the use of a closed flap ampu-

tation. A flap amputation was also employed in another extensive shrapnel wound of the popliteal space. In this instance amputation was required because the posterior two-thirds of the knee joint was avulsed, with resultant gangrene below the knee.

In performing closed flap amputations, equal flaps or circular skin incisions were made and the skin undercut. No tourniquet was used because of possible thrombosis. A long amputation knife was used to cut through the bulk of the muscle. The bone was sawed through. The artery and vein were tied together, except in high femoral amputation when preliminary ligation was performed. The nerves were not pulled down or injected, although the vessel accompanying the sciatic was occasionally tied. Bleeding was controlled with hot sponges and the larger vessels were tied with chromic suture. Muscle flaps were not made and the bone was not curetted nor the periosteum reflected back. Sulfanilamide crystals were dusted over the wound. The skin flaps were undermined sufficiently to bring them together snugly over the bone. Rubber tissue drains were inserted in either end of the wound and were removed in 48 hours.

Guillotine amputations.—Guillotine amputation is the procedure of choice in war surgery, but requires some explanation because its concept is so variable. It is primarily designed to eliminate destroyed, infected and nonviable tissue and to provide adequate drainage by remaining open. It must also provide a viable stump, be performed at a proper level and provide for early closure.

The site of amputation should be the lowest possible level, regardless of the utility of the stump, and *not* at the site of election. In the case of a compound fracture, the end of the proximal fragment should represent the saw line if sufficient soft tissue is present. Amputation above this level is a useless sacrifice of bone length unless a higher site is indicated by other considerations.

In performing this amputation, generous flaps should be provided if possible, especially if the amputation must be performed close to the site of election. These flaps are not closed but are undermined and retracted. Each layer of muscle is retracted as it is cut, making a slightly conical amputation stump.

Because of the large amount of serum exuding from the wound the application of skin traction is not immediately practicable. Twenty-four hours later, however, skin traction straps can be applied down to the edge of the skin flaps and attached to a weight and pulley with weights varying from 5 to 15 pounds depending on the site of amputation and the weight of the individual. The wound is dressed infrequently with 5 percent sulfathiazole ointment. If skin traction is delayed, or not applied, the skin retracts, leaving a large granulating wound with infected bone, necessitating the loss of much bone length by secondary amputation.

With traction, the skin is gradually pulled down over the stump, causing a gradual contraction of the wound. While artificial limbs can be made for guillotine amputation stumps having wide terminal bone and skin scars, these are, in general, not practical. Secondary plastic procedures have to be performed. After 5 to 8 weeks the stump is



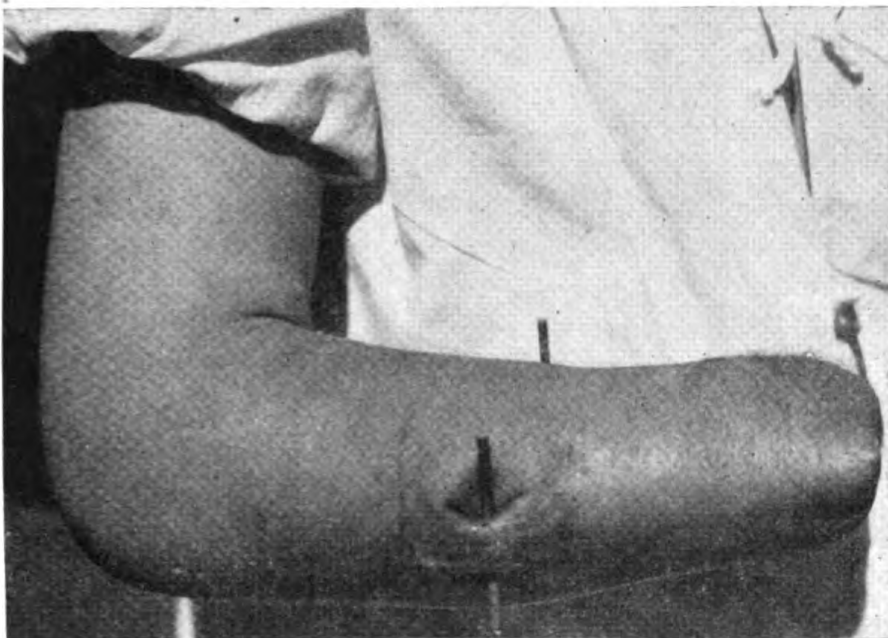
5. Lateral x-ray of short guillotine stump after plastic closure. The fibula is not removed, since the biceps attachment would be lost impairing the power of knee flexion.

ready for the closure. Where there is an adequate bone length the closure is performed in the usual manner of a flap amputation. However, when the original operation was performed at or near the minimal site of election because of the nature and location of the original injury, a different procedure was followed (fig. 5). The scar was care-

fully excised and the skin extensively undermined. From one-eighth to one-fourth inch of the bone was removed thus retaining the short bony lever intact. The skin was then brought over the bone and closed.

Provisional prosthesis.—After the stumps were healed, provisional prostheses were applied by means of plaster pylons. This initiated early shrinking of the stump, trained the patient to balance himself before receiving his permanent prosthesis and gave him assurance and confidence in his ability to get around.

Upper extremity.—Amputation of the upper extremity is a special problem and requires separate and careful consideration, because of the unsatisfactory experience in the last war and in civilian life with



6. Cineplastic motors of right forearm. Extensive mutilation of hand following explosion of dynamite necessitated amputation 1 inch above wrist joint. Three weeks later the cineplastic operation was performed. Wood pegs pass through dorsal and volar motors.

the wearing of artificial arms. It is simple to reproduce the lost function, that of weight bearing by artificial means, in leg amputations. Prehension, the specific function of the hand and arm, can be only imitated but cannot be duplicated.

For these reasons, three patients were operated upon by the cineplastic method, enabling the amputee to utilize the remaining muscles in the stump to operate a prosthesis along natural lines. By means of two skin tubes passed through the muscles of the forearm, and pegs placed in these tubes the prosthesis was attached to the arm. The same muscles that opened and closed the natural hand open and close the artificial hand (fig. 6).

The case of the double arm amputee is unusually difficult. While the one-armed man can still adjust himself to the major demands of living with his remaining sound arm, the man who has lost both arms must necessarily live in a different world. He is helpless and requires continuous assistance for even the minor pursuits of life. It is urgent that he be provided with a natural means of prehension by mechanical or surgical means. In one of the two such cases that presented them-



7. Forcipization operation right forearm amputation stump.

selves, a cineplastic operation was performed on one forearm. On the other a forcipization operation was done (fig. 7). The forearm was split into two pincer-like fingers, thus providing him with a natural means of prehension. Long before he returns to the United States, with the necessary delay in securing the proper prosthesis, he will be able to carry out many of his needs. This stump can also be fitted with a prosthesis which is operated by the opposing action of the two finger elements. The employment of such a prosthesis is optional.

D. WAR INJURIES OF THE EYE

A STUDY OF 118 CASES ENCOUNTERED AT U. S. NAVAL BASE HOSPITAL ———

ARTHUR M. CULLER

Commander (MC), U. S. N. R.

The practice of ophthalmology in the war zone presents essentially the same problems which one encounters in civil practice. Refractive errors and even such diseases as iritis and corneal ulcer are frequently regarded as minor lesions in comparison with gunshot injuries. Indeed, early attention by a specialist may save an injured eye that would be lost otherwise. Prompt expert care is not so critical in the management of many diseases of the eyes. Nevertheless, men incapacitated by headaches or poor vision, who have to be evacuated from the front, constitute just as much a loss of manpower as those with severe war wounds.

Ocular complaints at United States Naval Base Hospital ——— during a 1-year period show 10 times as many patients incapacitated and evacuated for refraction and disease, as were so handled because of injury to the eye. In addition to the hospitalized patients treated for disease of the eye, a large number were out-patients.

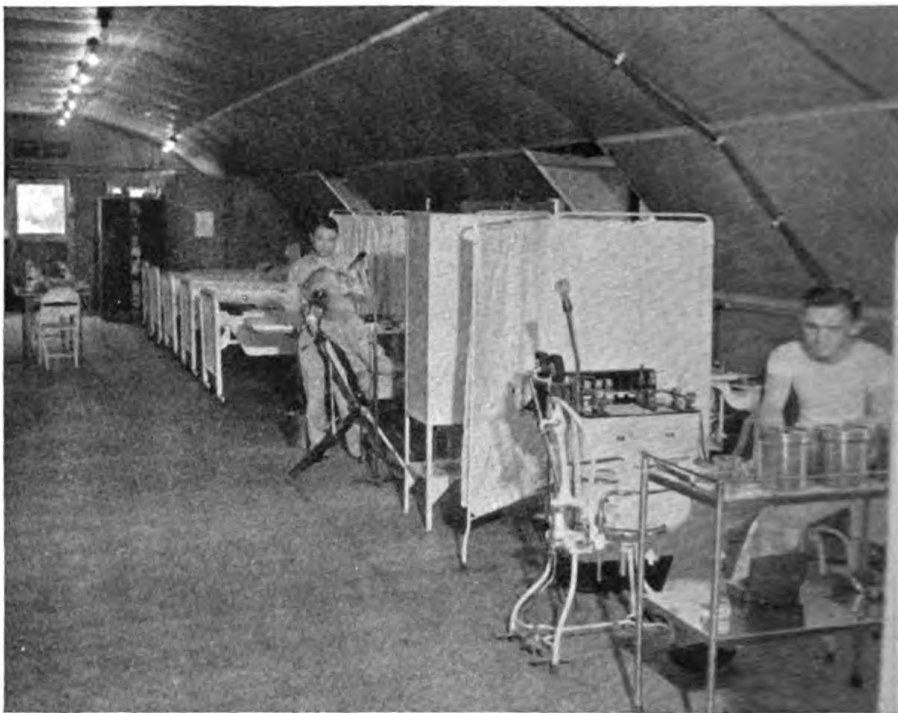
Approximately one-half of these patients were Navy and Marine Corps personnel. Since a visual acuity of 15/20, correctable to 20/20 in each eye, is required for enlistment in these branches of the service, it has been presumed that these men have eyes sufficiently normal that they will not cause trouble at the battle front. Contrary to expectations, the incidence of incapacitating asthenopia is greater in these groups than the incidence of incapacitating wounds, though not so high as the incidence in Army personnel. The explanation of this situation may lie in lowered vitality and muscle tone due to the poor hygienic conditions of the front, where irregular, unbalanced meals, and disturbed sleep are combined with constant ocular and mental strain. In addition many of these patients, evacuated to this hospital for refraction, developed clinical malaria while here. It is easy to understand how muscles able to overcome a moderate hyperopia under normal conditions might refuse to carry the same load under battle conditions.

The far-flung battle fronts of the present war necessitate provision for the care of all ordinary ocular ailments, as well as for wounds. A base hospital near the front thus needs the same equipment as a

hospital within the continental limits of the United States. Equipment for the diagnosis and treatment of perforating and nonperforating wounds is needed. A giant magnet and a Sweet localizer are essential requirements. Tiny foreign particles, sometimes invisible to the naked eye, are frequently found deeply embedded in the cornea. A slit lamp is particularly valuable at advance bases.

Experiences in the South Pacific area reveal that the chief causes of injuries to the eyes are (1) bullets, (2) shrapnel, (3) bombs, (4) shells, (5) thermal burns, (6) neighboring wounds, and (7) mental stress and shock.

Bullets.—The type of wound produced by a bullet depends upon (a)



1. Photograph of arrangement for treatments in eye clinic.

its trajectory and the kinetic energy with which the missile strikes, (b) the rotation of the missile about its long axis, and (c) the wobble of the bullet.

The wound is modified by the character of the tissues which the bullet first encounters, since bones and fascial planes often deflect the course of the bullet weirdly, and bony fragments become jagged secondary missiles which may do more damage than the bullet itself.

The effect of short-range bullets upon the dense bone of the orbital margin is that of great comminution. The entire orbital rim may be fragmented with tiny spicules of bone driven into the globe throughout the whole circumference. Even when the globe is only injured by secondary missiles the damage is often irreparable. Ult-

hoff reported that 83 percent of his patients with orbital injury required enucleation. In our experience 12 of 58 cases required early enucleation. There were undoubtedly other instances in which an eye had to be sacrificed later.

Anteroposterior bullet wounds are rare. Because of the usual lateral and prone position of the head in sighting a rifle, wounds of the orbit not infrequently constitute only the wounds of entrance of missiles which then pursue an oblique course through the face or sinuses, neck, and chest.

One type of injury deserving special comment is that in which the external angular process of the frontal bone and anterior portion of the temporal wall of the orbit are more or less completely carried away, giving an exposure of the orbital contents, much like that afforded by the Krönlein osteoplastic resection. "Krönlein-wound" has been suggested as a designation for this injury.

Spent bullets may merely cause contusions or lodge in the soft tissues. When an eyeball is struck by a bullet the wound is different from that produced by the simple course of a bullet through soft tissues. From a hydrodynamic standpoint, the eye is a closed sphere filled with fluid. When a bullet strikes it, a tremendous kinetic energy is transmitted suddenly in all directions by the fluid and the eyeball literally explodes in the socket. Bits of skin, lashes, uveal tissue, etc., are scattered throughout the orbital contents. This presents a particularly difficult problem in plastic surgery. However, this type of injury is rarely seen, since it is nearly always immediately fatal.

Shrapnel.—As a contrast to injuries in civil life, where ocular wounds are usually monocular and single, war injuries from shrapnel are usually binocular and multiple. All of the wounds produced by missiles have the common characteristic that the wound of entrance is smaller than the internal injury. These missiles carry clothing, dirt, hair, and skin into the wounds. Bones encountered often splinter and act as secondary missiles. These implantations may give rise to serious complications. Invariably these wounds are accompanied by considerable maceration of tissue, thus differing from clean surgical incisions, in that the toxins of necrotic tissue greatly delay reparative processes.

The most common war injury of the eye is due to shrapnel. The face and eyelids may be so incrustated with incompletely burned powder grains, gravel, mud, and metal particles that there is the blue-black appearance of a tattoo, in which the conjunctiva and cornea share. The lids are contused and lacerated. Tears of the lid margins are common. There may be contusion gangrene from the sloughing of necrotic tissue. The lids swell shut rapidly. The conjunctiva becomes chemotic. Focal suppuration develops. To the psychic trauma of the

injury is added the fear of blindness when the patient is unable to open his eyes. If seen soon after the injury, shock is usually the first consideration.

The treatment of these wounds should be adapted to the individual case. Cleansing with soap and water and irrigation is necessary as a first step but should not be carried to the extreme of increasing the reaction. The immediate problem is the avoidance of thrombosis due to stasis and swelling. The partially burned powder grains and dirt form a permanent tattoo unless they are painstakingly removed, and there is no solvent which removes them. It is necessary to remove them one at a time, with a loop and pointed spud, being careful not to produce a severe reaction by trying to do too much at one attempt. The removal of the embedded particles should be delayed until the immediate reaction has subsided. Sulfonamide drugs by mouth, atropine and 5 percent sulfathiazole ointment in the eye, and the continuous application of ice compresses constitute the best treatment procedures.

Shells.—With injuries arising from shell fragments may be included those due to bombs, grenades, and because of their similarity in effect, mines and torpedoes. These produce gross lacerations, wide areas of maceration, crushing, splintering, and dissecting wounds.

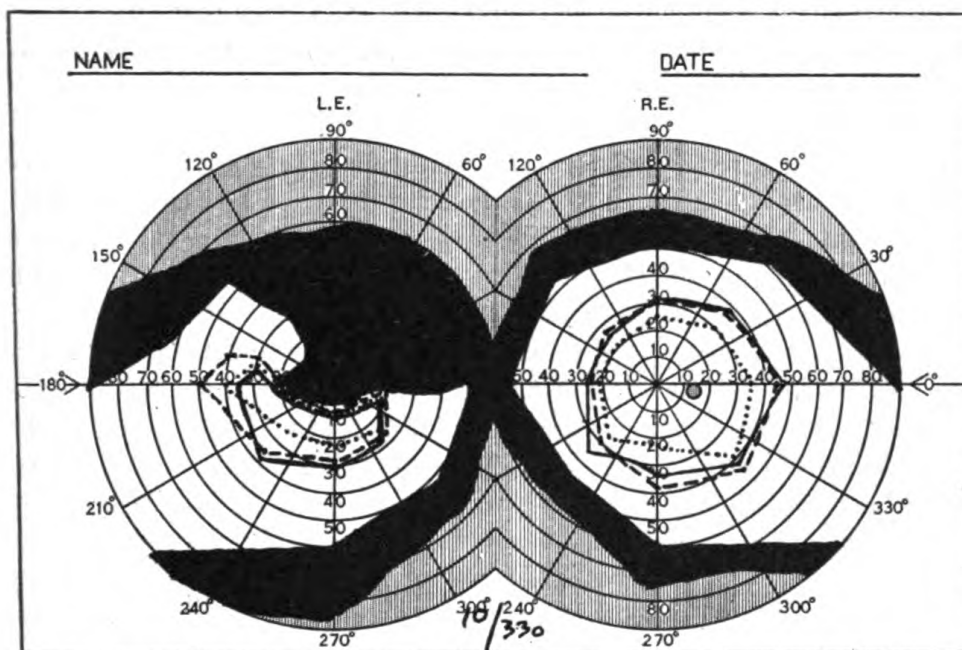
Explosive bombs.—Explosive bombs differ from shells, since they are propelled by gravity, and in that they have a thinner shell and contain a larger percentage of high explosive. The casing breaks into smaller fragments, perhaps as many as 5,000, with a much higher velocity and a longer range than the fragments of a shell.

The ocular casualties from air raids are of three principal types. These types result from (1) burns, (2) blast injuries, and (3) direct trauma. The typical injuries caused by bombs are similar to those produced by shrapnel except that in addition to the tattooing of the tissues with sand and dirt, there may be powder granules and oil embedded in the eyelids, conjunctiva, and cornea. Multiple burns are also common. Sudden compression may result in retrobulbar hemorrhage with proptosis, total loss of vision, and subsequent optic atrophy, extensive intraocular hemorrhage from ruptured retinal vessels or iridodialysis, rupture of the choroid, or macular changes. Acute iritis and acute secondary glaucoma coming on about a week after the injury have been reported. Perforating injuries are more likely to be due to splinters of wood, glass, or masonry, than to fragments of metal.

Thermal burns.—Thermal burns provide a higher percentage of war injuries in this than in any previous war. The increased use of incendiary bombs, and fires started from the demolition of fuel storage reservoirs are largely responsible for the frequency of these injuries.

Most of the burns, in the South Pacific area, have involved the lids principally, rather than the eyeball. Bland treatment with mineral oil, atropine, and ice compresses has been sufficient for all the burns of the globe encountered here. Immobilization of the lids to promote epithelization has been accomplished in some instances by suturing the lid margins together. Early skin grafting of the lids is sometimes necessary to avoid cicatricial contractures which may lead to exposure keratitis.

Associated with neighboring wounds.—Half of the cranial nerves have some connection with the eyes. In addition to the ocular lesions from neighboring wounds, the eye also suffers from a high percentage of cranial lesions.



2. Field defect in rupture of choroid (OS) from neighboring wound. Broken line represents field for blue, dotted line for red, solid line for green.

Tears in the choroid are common. The retinal vessels may pass over these undisturbed. Retinal lesions are more rare. Hemorrhages into the retina are usually associated with more extensive choroidal hemorrhages. The following case reports are illustrative:

A private, USMC, age 19 years, sustained a shrapnel wound immediately below the center of the left orbital margin. The floor of the orbit showed a linear fracture without fragmentation. A fragment of steel, 1- by 5- by 3-mm., was visualized by x-ray embedded in the roof of the maxillary sinus. One week after the injury, the left eye showed no opacities in the media. The rings were blurred. Three disc diameters below the nerve head and extending to the periphery below was a large area of rarefaction in the choroid with small clumps of dark brown pigment scattered throughout this area. Hemorrhagic remnants

surrounded several small retinal vessels. There was a dark remnant of a vitreous hemorrhage extending forward 8 diopters into the vitreous. There was no gross field defect. Visual acuity was 6/12.

A sergeant, USMC, age 24 years, sustained a small, lacerated wound of entrance in the left temple at the level of and 30 mm. behind the outer canthus. X-rays showed a fracture of the zygoma, a blood-filled antrum and a fragment, 10- by 12- by 8-mm., lodged beneath the mucous membrane overlying the posterior portion of the left lower turbinate. The day after the injury, examination of the left eye showed that the visual acuity was light perception. The media were clear. There was swelling of the lower border of the nerve head. Gray, edematous streaks extended along the inferior temporal vessels. There were a few linear hemorrhages into the retina. There was a large choroidal hemorrhage extending from the disc margin down and out. Two weeks later this had cleared sufficiently to permit the observation of several semilunar ruptures in the choroid.

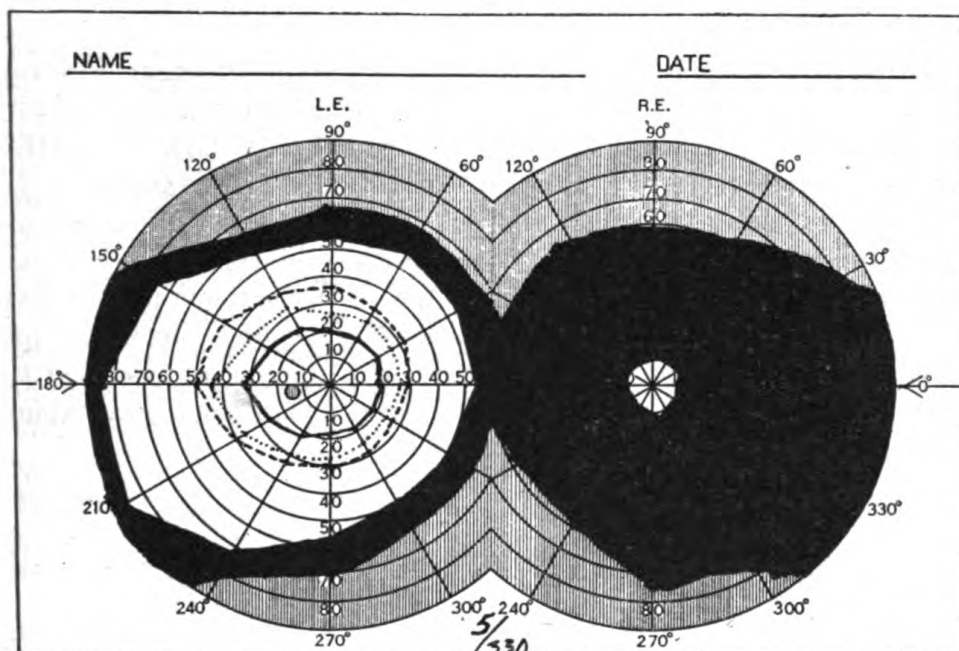
Proliferative traumatic chorioretinitis is a frequent sequela of choroidal tears. The vitreous hemorrhage, which frequently organizes, provokes an irritation of the connective tissue elements of the choroid. Connective tissue proliferation then occurs, which is easily confused with a true proliferative retinitis. The papulomacular region is the usual site because it is the most fragile and the most easily torn. Pathological preparations show that the cicatricial sheet intimately envelops the retina and choroid, preventing subsequent separation.

The optic nerve may be damaged by direct or indirect trauma, at the papilla, in the retrobulbar portion or in the region of the optic foramen. The most typical lesion is avulsion of the nerve, due to violent traction on the nerve. Profuse hemorrhage occurs due to rupture of the retinal and the short posterior ciliary arteries. The hemorrhages occur both into the globe and behind it. The presenting signs are usually blindness and proptosis associated with a neighboring wound. The papilla may be only partially torn. An illustrative case report follows:

A captain, USMC, sustained a shrapnel wound over the right zygoma. On examination at this hospital the following day, a clean lacerated, irregular wound, 4 by 7 cm., centered 5 mm. below and 20 cm. behind the external canthus, was found. Vision was nil in the right eye, normal in the left. The right eye was proptosed 8 mm. The palpebral fissure was stretched open by profound chemosis, which was also overhanging the limbus on all sides. The cornea was lusterless and gray from exposure. Suffused blood filled the interspaces of the episcleral tissue. Tension was soft. There was no systemic evidence of infection. The general condition was good. X-rays showed a fracture of the zygoma and an irregular metallic fragment 10- by 10- by 5-mm. embedded in the mesial wall of the orbit, 30 mm. behind and 5 mm. above the glabella. The right eye was enucleated the same afternoon. At operation, complete avulsion of the optic nerve was found. The retina was completely detached by a large subretinal hemorrhage. A 12-mm. glass ball was inserted and the lids sutured over the brawny indurated conjunctiva. Convalescence was uneventful.

Mental stress and shock; psychic trauma.—Psychic disturbances of all sorts form an important element of medical practice at every battle front. The various ocular manifestations of psychic trauma reflect the influence of previous eye trouble or of overpowering fear concerned with the eyes. This fear is sometimes a fear of failure of the eyes in a crucial task on watch, sometimes a fear of blindness, and sometimes an exhibition of the overwhelming horror and refusal of the individual to meet the sights of the battlefield. The following cases are selected from the records of patients who took part in early action where the factors of exposure and malnutrition undoubtedly predisposed to emotional stresses:

An ensign, a few weeks out of college, where he had had some difficulty because of a hyperopic astigmatism of plus 1.50 D. in one eye and plus 2.75 D. in



3. Fields in case of monocular hysterical amblyopia. Broken line represents field to blue test object, dotted line to red, solid line to green.

the other and a convergence insufficiency, was assigned the duty as a communication officer at ——. This duty entailed continuous responsibility 24 hours a day, great nervous tension, and a heavy use of the eyes. After 3 weeks of this duty, during which he had many frontal headaches, and at the time of a shelling of his position, he suddenly became unable to read the letters of the ciphers. The visual acuity with correction of the refractive error was 6/30 in each eye. Visual fields were contracted to an oval area 3° by 6° to a 10 mm. test object at 1 meter. The size of the area was the same with a 10 mm. test object at 2 meters. The fundus showed a pseudopapillitis. A frank analysis of the problem and a change of duty resulted in prompt improvement of his visual acuity to 6/6.

A Marine Corps machine gunner stooped over for ammunition while in action. While in this position the enemy opened fire from the rear of their emplacement.

Another member of his crew swung the gun around and opened fire in return. The muzzle of the gun being fired was about 6 inches above the right side of his face. He sustained powder burns about the right eye. The next day he complained of being deaf in his right ear and blind in his right eye. Visual acuity was OD-M. S., OS-6/6. The pupillary reactions were equal and active. Except for particles of powder embedded in the skin of the lids and face, there was no evidence of injury to his eye. He mapped a tubular field with his right eye and a normal field with his left eye. With a red glass before his left eye he was able to read a message written with a red pencil which could only have been visible to his right eye. He had glove anesthesia of right hand and cornea anesthesia of the right eye. Normal visual acuity and normal fields were obtained immediately after the installation of one drop of dionin in the right eye. The deafness was due to a rupture of the ear drum. While malingering was not ruled out by our examination, the patient was fully cooperative and had no reason for malingering, as his organic lesion would have removed him from combat duty as effectively as his imaginary ailment. It is believed that this case constitutes an example of the rare disease, monocular hysteric amblyopia, induced by strong fear of damage to his right eye.

Those presenting themselves with the complaint of night blindness form a composite group in which the following factors are of varying importance: (a) A constitutional abnormality of dark adaptation, (b) refractive errors, (c) physical exhaustion, (d) avitaminosis, (e) nervous exhaustion, (f) fear, and (g) hysteria. Night blindness may occur in epidemic form, whole companies even reporting with the same complaint. When this occurs a few of the patients usually have organic disease, and the remainder are examples of hysteria and malingery. However, the lack of vitamin A in the diet of troops at the front, associated with mental and physical exhaustion, may explain some epidemics.

SUMMARY

1. The same diseases of the eye which are encountered in civil life occur in the war zone.
2. The most common war injuries of the eye are those due to shrapnel.
3. Ocular casualties from air raids are of three principal types: Those due to burns, blast injuries, and direct trauma.
4. Thermal burns form a higher percentage of war injuries than in any previous war. In extensive burns of the face, immobilization of the lids by suturing the lid margins together and early skin grafting are recommended.
5. Chorioretinal hemorrhages are commonly associated with neighboring wounds. These may be accompanied by choroidal tears and followed by proliferative traumatic chorioretinitis.
6. Psychic trauma may reflect the influence of previous eye trouble or overpowering fear concerned with the eyes.

E. THE DEPARTMENT OF OTORHINOLARYNGOLOGY U. S. NAVAL BASE HOSPITAL ———

LE VAL LUND

Lieutenant Commander (MC) U. S. N. R.

and

DONALD J. CRONIN

Lieutenant (MC) U. S. N. R.

The staff of this department was interested not only in the treatment of war injuries of the ear, nose, throat, and face, but also in that of the usual affections of these organs occurring preponderantly in a younger age group. In addition to the treatment rendered to hospitalized patients during the first year of the operation of this hospital, a large out-patient clinic was established.

Some of the patients had only recently arrived in this tropical climate. Others had already spent many months in the war zone area. In general, no special problems were encountered from the adjustment to climatic conditions marked by excessive heat and humidity, other than a high incidence of fungus infection of the ears.

The fundamental object of the out-patient clinic was to maintain physical fitness and to prevent invalidism. By serving as a diagnostic center for obscure complaints referable to the ear, nose, and throat, and providing treatment after early recognition, this department helped many to remain on duty without any appreciable loss of efficiency.

The predominant complaint was frontal headache, intermittent in character. Because of the obscure etiology of so vague a symptom, it was necessary to carry out extensive investigation of the sinuses, the eyes, and the dental organs. Of the patients with this primary complaint only a small number were found to have an organic basis for their symptoms. A deviated septum was found to be the probable cause in several aviators. Coming out of a dive they experienced severe frontal headache which persisted as a dull ache for many hours. Their inability to make the necessary physiologic adjustments was based on this organic defect.

External otitis media occurred in many instances. This disease was, for the most part, mycotic in origin. For those external otitic lesions accompanied by marked edema, wicks of 95 percent alcohol were applied for 1 to 2 days followed by the application of wicks saturated with 5 percent sulfathiazole ointment. Occasionally wicks containing 1 percent salicylic acid in 95 percent alcohol were applied

when edema was not marked or apparent. These patients, as a rule, responded quite readily to treatment, although recurrence was frequent.

Other conditions encountered were eustachian salpingitis in 240 patients, impacted cerumen in 113, deviated septum in 209, allergic rhinitis in 170, acute rhinitis in 436, and acute tonsillitis in 240.

Of the hospitalized patients, 33 percent were admitted with acute or chronic tonsillitis and 19 percent with chronic otitis media. Many of the latter group were cases of long standing, in which the disease had existed prior to enlistment. Acute otitis media occurred in 26 cases. Traumatic rupture of the ear drum was found in 42 cases and acute sinusitis in 199 instances. Eight cases of diphtheria occurred; positive cultures were obtained in all. Although antitoxin was administered in all cases, transient paresis of the pharyngeal muscles occurred in 3 instances.

GUNSHOT WOUNDS

Thirty-eight facial gunshot wounds were treated by the staff of this department. This figure includes only facial wounds involving the oral or nasal cavities, the nose, the accessory sinuses, or the facial bones. It does not take into consideration wounds of the orbit or of the numerous superficial facial lacerations which were secondary to more serious injuries. Due to the exigencies of war, our more seriously wounded patients were kept for a limited time only, the average period of hospitalization being 13.9 days per patient. Consequently, treatment was directed essentially toward preparing the patient for later surgical and plastic procedures.

The severity of gunshot wounds of the face depends upon a number of factors, such as the speed, shape, and type of missile. Bullet wounds, especially those inflicted by the Japanese .25-caliber rifle, were less damaging than shell fragment wounds. The former exhibited a small wound of entrance and a larger jagged wound of exit in which splinters or fragments of bone were present. Shell fragments were less penetrating but more destructive than bullets.

The wounds caused by shell fragments and shrapnel were more extensive, very irregular and contained larger but fewer particles of bone; in addition, one or more metallic foreign bodies were apt to be present.

Almost all gunshot wounds of the face were associated with fractures of the adjacent facial bones. The fractures were usually extensively comminuted. In our series of such cases, 83 percent of the patients with facial wounds had concurrent fractures of the facial bones. The bones which were fractured, in order of frequency, were the mandible, nasal bones, malar bones, and maxilla.

Facial gunshot wounds were usually infected, because dirt and other foreign material were carried into the wound. Wounds which communicated with the nasal cavity, oral cavity, or paranasal sinuses were always infected, since the traumatized tissues were exposed to the pyogenic bacteria in the secretions. Another important factor contributing to the incidence of infection was the interval between emergency treatment of the patient at the front and his arrival at this hospital; this ranged from 1 to 3 days. During this time, dressings became dirty and bloodstained, since there was often little opportunity for renewal.

The general condition of the patients received here was good in almost every case. On the field they had received emergency treatment which consisted of antishock and tetanus therapy, and cleansing and dressing of the initial wound. All wounds had been impregnated with sulfanilamide crystals or sulfathiazole powder. Treatment at this base was directed toward control of sepsis, attention to soft tissue damage, and the fixation of fragments.

As soon as the patients were received upon the ward, oral sulfathiazole therapy was started. The wounds were then cleansed with soap and water and carefully examined for foreign bodies. The next step was debridement, which consisted of removing detached particles of bone, loose teeth and roots, and all devitalized tissue. Fragments of bone still attached to soft tissue were saved since they might possess regenerative power. Radiating lacerations were sutured and skin flaps were replaced even though almost detached. Fine drains were inserted to allow the escape of blood and serum. No attempt was made to close extensive wounds or wounds complicated by fractures at the first treatment session. Instead, sulfanilamide crystals were sprinkled on the surface and the wounds were covered with gauze packs soaked in warm saline or boric acid solution.

Wounds definitely infected were first treated by such warm fomentations and the local application of sulfanilamide crystals. The warm, moist packs were changed every 30 to 60 minutes. If the wounds communicated with the oral and nasal cavities or paranasal sinuses, some form of dependent drainage was established, preferably intra-orally or intranasally. The nasal mucosa was kept shrunk and as sterile as possible. The mouth was irrigated frequently with mild antiseptic solutions. The soft parts and fractured fragments were immobilized temporarily. When signs of local inflammation subsided, debridement of the wounds was then done and the soft tissues were repaired.

Thirty-seven percent of the facial injuries were complicated by simple or compound fractures which extended into the paranasal sinuses. The sinuses most commonly involved were the maxillary and the frontal. The compound fracture injuries were treated by

simple excision and removal of detached particles of bone. Foreign bodies were removed if they were easily accessible and temporary drainage was established. Simple fractures were treated as conservatively as possible. Puncture and irrigation was avoided unless definite infection was present.

Immobilization of the reduced fractured fragments was, in most cases, accomplished with the collaboration of the dental officers. Immobilization was done as soon as the swelling and edema subsided sufficiently to allow reduction. Immobilization at this time was advantageous because the fragments were more easily put into position and because the splinting reduced muscle tension, thereby facilitating repair and also relieving pain.

Gunshot wounds in the zygomatic region caused extensive damage. In such cases, the malar bone, as well as various other bones in that region, was involved. The zygoma itself was usually easy to reduce since in none of our cases was it extensively comminuted. The method used was that of grasping the infra-orbital ridge with an ordinary towel clip and manipulating the fragments back into position. It was found unnecessary to retain such fragments with a splint.

Severely comminuted fractures of the nasal bones were not seen. Two superficial wounds of the nose, neither of which required more than simple cleansing and suturing, were encountered. Two patients had suffered wounds through the nasal septum, inflicted by missiles passing through the maxilla and ethmoid bones. The damage to the septum and nasal wall was not extensive, and the fragments of cartilage and bone were held in place by Simpson intranasal tampons.

Several fractures of the maxilla were encountered, including those in which the alveolar ridge had been shattered and the more serious cases in which the entire maxilla had been partially or entirely fractured with the bone displaced backward and downward. In the former cases, fragments of bone and teeth were removed and then lacerated mucosa was sutured together. In the latter cases, an intra-oral splint was constructed, the details of the construction of which will be considered in the case reports which follow. This splint was fastened to the upper teeth and then wired to a plaster head cap. Occasionally it was necessary to use intramaxillary elastic bands to correct the antero-posterior displacement.

The immobilization of fractures of the mandible was almost entirely a dental problem. It was fortunate that none presented a difficult problem as regards splinting. All of the patients had stable teeth on the unaffected side, which permitted adequate anchorage to the maxilla. Consequently, intermaxillary or intramaxillary wiring was sufficient for immobilization. In no case was open reduction necessary.

ILLUSTRATIVE CASE REPORTS

The following case reports have been selected to exemplify the type of cases observed here and the problems encountered in their treatment:

Case 1.—A 20-year-old man entered this hospital on January 24, 1943, 2 days following injury by mortar fire. Examination revealed a small wound of entrance about 1.5 cm. in diameter, and situated just behind the posterior border of the right sternocleidomastoid muscle and about 3 cm. below the tip of the right mastoid. The fragment coursed upward and to the left, emerging through the anterior pillar of the right tonsil, creasing the base of the tongue, perforating the hard palate at about the midline and emerging at the junction of the anterior and medial wall of the left maxilla. There was extensive comminution of the left superior maxilla and the main fragment was displaced posteriorly and downward. Several teeth were missing and there was considerable loss of soft tissue (3 to 4 cm. in diameter). The wound was infected. There was a slight chemosis of the left lids and a subconjunctival hemorrhage.

The laboratory examinations were essentially negative. X-ray films showed an extensive comminuted fracture of the left maxilla and a large defect of the maxilla in the region of the left cuspid and incisor area. The fracture extended into the floor of the left naris and into the base and roof of the left antrum. Both antra were clouded. There was no metal in the soft tissue.

Sulfathiazole was administered in doses of 15 gr. every 4 hours. The wounds were cleansed and the surface impregnated with sulfanilamide crystals. Warm saline packs were applied and were changed every hour. Because of the swelling and edema no reduction was attempted at that time. On his 5th hospital day the edema subsided sufficiently to allow reduction and splinting.

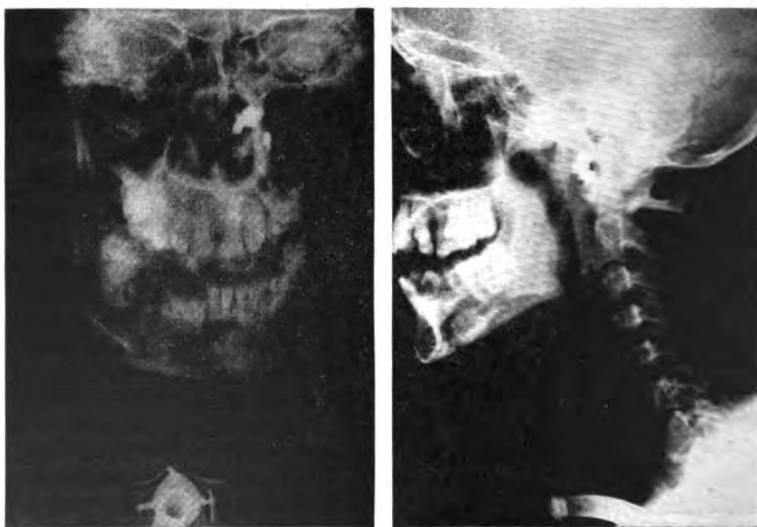
Our major problem was that of immobilizing the reduced fragments, since our splints were necessarily makeshift. The splinting was accomplished with the help of officers of the dental department. A deep impression tray was selected to which wires had been soldered in such a manner that when the tray was inserted, the wires projected from the mouth and curved backward in a plane paralleling the occlusion of the mandible. The tray was filled with modeling compound and then placed in position to support and stabilize the reduced fragments. The impression was then chilled and the wires of the tray were fastened to similar wires projecting from a plaster head cap (fig. 1). This device proved satisfactory and held the reduced fragments in perfect alinement.

Further management consisted only of supportive therapy and daily dressings. The patient was evacuated 11 days after arrival. At the time of evacuation the patient's condition was excellent. The wounds of his neck and tonsillar pillar had healed. The facial wound was clean and was healing normally.

Case 2.—A 20-year-old man was admitted on February 13, 1943, 2 days after suffering a gunshot wound from a 30-30 caliber rifle bullet. The wound of entrance was through the right orbit. The bullet coursed downward and to the left passing through the right ethmoid cells and the nasal septum, and made its exit through the body and alveolar process of the left superior maxilla. The maxilla was badly comminuted and the lateral wall and a large portion of the alveolar process had been destroyed. A small segment of the right palatine process was also missing. The right antrum communicated with the oral and nasal cavities and also was exposed externally. The skin had been loosely sutured over the right antrum into which vaseline gauze had been packed. Most of the sutures had already sloughed out. There was chemosis of the inferior bulbar conjunctiva of the left eye. The right eye had been enucleated. There was a small laceration and defect of the medial one-third of the right lower lid. The right fornix had been destroyed. The nasal septum was fractured and perforated



1. Intra-oral maxillary splint.

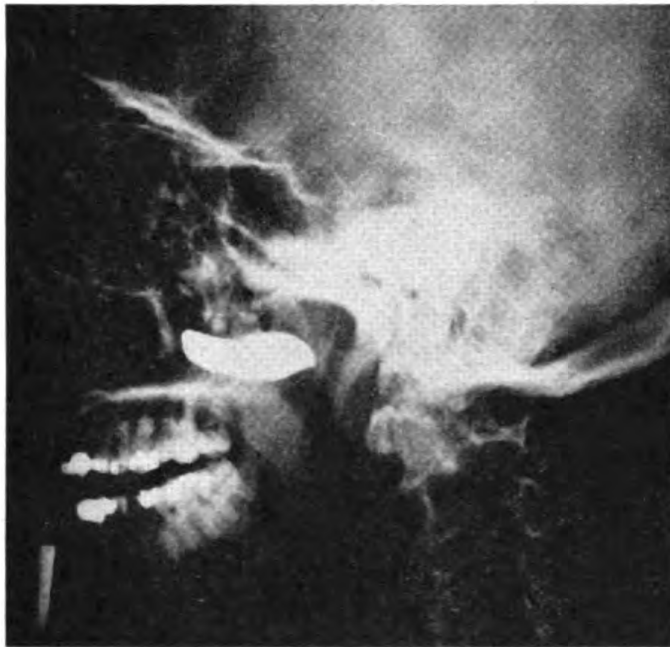


2. Comminuted fracture right mandible, extending from angle of mandible to incisor teeth. Fragments of two molar teeth remain on right. Shrapnel passed through tongue and lodged in soft tissue of posterior nasopharynx on left side. Two pieces of metal seen apparently in contact with anterior portion of atlas.

and the right middle and inferior turbinates had been crushed and were partially destroyed.

Laboratory studies gave essentially negative results. X-ray findings showed an extensive comminuted fracture of the left ethmoid cells, the floor and lateral wall of the left antrum, left maxilla, and left mandible. The mandible was fractured in the region of the third molar tooth and was in good position. The left maxilla was badly fragmented. The fracture extended into the floor and medial wall of the left orbit.

The wounds were cleansed carefully and lightly packed with gauze saturated with warm saline solution. Daily dressings and supportive treatment was continued until the tenth hospital day, at which time the edema and infection had subsided sufficiently to permit reduction of the fractures.



3. Struck by Japanese sniper with .25-caliber bullet. Entrance wound 2 inches long, behind outer canthus of left eye, over zygoma. Fracture involved floor of orbit and posterior wall of left antrum. A large piece of metal lay in the nasopharynx almost in the midline. Because of swelling around the temporo-mandibular joint, patient could not open his mouth more than $\frac{1}{4}$ inch. Removal of the foreign body by probing through the nose was unsuccessful. Second x-ray revealed the bullet to be projecting from the floor of the nose and hanging over into the nasopharynx. Before another attempt at removal was made, patient coughed and brought forth the .25-caliber slug.

The problem at that time was to construct a splint which would take the place of the partially destroyed alveolar and palatine processes of the left maxilla and thus support the sagging edematous tissues of the left maxillary region. First, the buccal mucosa of the left cheek was sutured to the mucosa of the remaining alveolar and palatine processes. This closed off the wound from the oral cavity. Then an acrylic splint was devised which when placed into position next to the hard palate effectively supported the soft tissues. This splint was anchored to the maxillary teeth on the sound side. Then the mandible and maxilla were fastened together by intramaxillary wiring. At the time of evacuation, a few days later, the wound showed normal healing changes, without infection.

F. UROLOGY AT A BASE HOSPITAL IN THE WAR ZONE

EXPERIENCES DURING ONE YEAR AT U. S. NAVAL BASE HOSPITAL ———

OLIVER W. BUTLER
Commander (MC) U. S. N. R.

MARION W. COLEMAN
Commander (MC) U. S. N. R.

and

JAMES M. MACNISH
Lieutenant Commander (MC) U. S. N. R.

This is a report of the activities of the Department of Urology at United States Naval Base Hospital ——— during the first 12 months of its operation. A well-equipped urology department for diagnosis and treatment is essential in an institution of this sort, for one encounters not only the types of cases common to civilian practice, but also those in which war wounds of various urogenital structures occur to offer problems of varying degree. Through improvisation and periodic addition to equipment furnished, the facilities have steadily improved but fall short in some respects; for example, had there been available a resectoscope and an electrosurgical unit, a number of patients with small median prostatic bars could have been cared for here, returned to duty, and saved the necessity of evacuation to the United States.

The cases under supervision of this department have been assigned in the main to two wards. The urology clinic adjoins the x-ray department and is used for cystoscopic examinations, minor urological surgery, and routine examinations and treatment of both hospitalized and dispensary patients.

DISEASES OF THE LOWER URINARY TRACT

Venereal disease.—Fortunately, there has been no vexatious venereal disease problem at this base; only 4 cases of acute and 16 cases of chronic gonorrhea have been treated. There have been no cases of primary syphilis. Two cases of secondary syphilis, contracted prior to leaving the United States, were seen.

There have been 2,836 Kahn tests made on patients admitted to this hospital. The test has been routine on all colored admissions, and on others when indicated. There were 139 individuals with positive reactions, predominantly among colored troopers. These patients had acquired the disease in the United States and were under treat-

ment for syphilis. This was carried out during their stay in the hospital or was started here as the situation required. There was no reason to believe that the positive serologic reactions in the 139 cases were caused by malaria.

Urethral stricture.—Stricture of the urethra was a very common finding in the colored troops, and many cases of frequency and some with enuresis were relieved following dilatation. The stricture was often of filiform size, and since a good set of urethral sounds is apparently not standard field equipment, they had gone untreated, except for oral medication, for many months.

Prostatitis.—Due to the fact that from 20 or more white blood corpuscles to the high dry microscopic field were almost invariably found in the prostatic secretion during routine urologic examinations, this finding was not considered pathological. Sexual inactivity may account in part for this circumstance. The diagnosis of chronic prostatitis was made where the secretion contained pus cells in clumps and the examination revealed bogginess or areas of induration of the prostate gland. There were no cases of acute prostatitis or abscess of the prostate.

Granuloma venereum.—Twelve cases of granuloma venereum, all in colored troopers, were treated. In no case was the disease contracted here. The lesion developed on the troop transports or shortly after landing and all were in one organization. Three of these patients, with redundant foreskin and with the lesion on the prepuce, were cured by circumcision. The rest were treated with antimony (one-half to 2 percent solution applied locally) and the refractory cases in addition were given intravenous injections of 1 percent tartar emetic. All were cured, although one patient was under treatment for 90 days. Sulfonamide drugs apparently did not appear to influence the healing of the ulcer.

Filariasis.—Eighteen cases of acute painless epididymitis with hydrocele, diagnosed clinically as filariasis, were seen but we found no parasites to substantiate this diagnosis. The patients had all been based originally in the Samoan or Wallis Island groups. With one or two exceptions the lesions were unilateral and all ran a very mild, afebrile course. After 10 to 14 days in bed they were returned to duty. Observation of these cases did not extend over a sufficient length of time to determine if there would be any permanent scarring of the epididymis.

Hunner's ulcer.—Localized submucous fibrosis or Hunner's ulcer was found in four of the colored troops. The symptoms were typical and dated back 12 to 18 months. The patients were evacuated to the United States untreated.

Median bar.—As mentioned previously several cases of bladder neck

contracture with median bar formation were encountered. These patients were mostly white men in their late thirties or early forties, with residual urine varying from none to several ounces. They were evacuated if the symptoms were at all pronounced.

UPPER URINARY TRACT

Urinary calculus.—Calculus disease of the upper urinary tract, and hematuria with or without pain, has comprised the major portion of all cases admitted to the urologic ward. One or more thorough investigations of the urinary tract failed to reveal the cause of the bleeding in quite a number of the cases, even when the bleeding was sufficient to color the urine; in one case it was sufficient to produce pain from distention of the renal pelvis with blood clots. The majority of these cases of hematuria were no doubt produced by urinary calculi not visible on the x-ray film.

Urinary calculi demonstrated by x-ray were usually solitary, hard, spiculated stones which passed voluntarily or after minor cystoscopic procedures. Surgical removal was necessary in only three patients; in two the stone was located in the upper ureter and in the third in the lower ureter. The stones measured over 1 cm. in diameter and were producing obstructive symptoms. Patients with bilateral or multiple stones were evacuated.

No case of urinary calculus has been seen in members of the colored race, and, moreover, none has given the symptoms of typical renal colic. Investigation of the upper urinary tract in well over 100 colored soldiers, who complained of vague abdominal symptoms, revealed that in every case except 1 the upper urinary tract was normal. In this man an ectopic right kidney in sacral position, with poor function and producing abdominal pain, was removed.

This brings up the question as to the incidence of stone in this area as compared to that in the United States. There is no accurate way of judging, but there has been no case among the civilian population during the past year and it is felt, therefore, that the incidence is no higher, and may be less.

WOUNDS OF UROGENITAL TRACT

Young's classification of wounds of the urogenital tract and the methods of treatment conform perfectly with our experiences at this hospital. During active hostilities patients were received here, on the average, from 12 to 48 hours from the time they were wounded. The gravity of the case depended not only upon the structures involved but also upon the type of missile causing the injury. The Japanese .25-caliber bullet produced the least destruction to the tissues, while

shrapnel from explosive types of shell or bomb produced extensive damage with severe shock. Immediate surgery is practically always indicated in severe wounds of the upper urinary tract, complicated or uncomplicated, and also in intraperitoneal bladder wounds. This was not possible on the battlefield during the Solomon Islands action. Nevertheless, excellent first-aid and emergency surgery was rendered on the field in most cases. A few patients received from the theater of action with severe wounds were practically moribund and died within 24 hours after arrival. Only one patient had been operated upon previously. In this instance there was extensive damage to the cortex of the left kidney and multiple penetrating wounds of the intestine. Failure to close a rent in the posterior wall of the stomach resulted in death 48 hours after the operation had been performed.

Extraperitoneal injury of the bladder.—Simple penetrating wounds of the bladder alone were not encountered. Most often they were complicated by very serious lesions to other structures and organs. The rectum was involved in three cases, and on arrival at this hospital urine and feces were escaping from the posterior wound. Colostomy was done in one case, and was indicated in the other two as soon as their general condition would permit, but it was necessary to evacuate them before this could be done.

Wounds of the bladder associated with fracture of the pelvis were treated by cystotomy, foreign body removal and suprapubic drainage of the pelvis and bladder.

Wounds of the genitalia and urethra.—The scrotum was most frequently involved in wounds of the genitalia and lower urinary tract. In a few cases the injury was not extensive, being limited to one testis, and conservative treatment was carried out. A small foreign body was removed from the left testis in one case without permanent damage to the organ.

There was only one case of gunshot wound of the penis and urethra, in which there was almost complete severance of the distal 1 inch of the penis. This had been sutured within the first hour, splinted by catheter, apparently with an excellent result.

Sulfonamide drugs, chiefly sulfathiazole, have been our mainstay for preventing and combating infections. Large doses have been given by mouth to all patients with wounds. In every case operated upon, whether clean or infected, or whether the wound was to be closed or to remain open, a liberal quantity of the drug was applied locally. In only 1 case was there any ill effect noted to the upper urinary tract. This patient, age 50 years, developed a temporary blocking of the left ureter with crystals of sulfapyridine, and was immediately relieved by the passage of a ureteral catheter.

SUMMARY

1. The absence of acute venereal disease at this base has relieved us of an annoying problem.
2. There have been no urinary calculi in the colored personnel.
3. Kidney complications from the use of sulfonamide drugs in the healthy young male is very rare.



WORK OUTPUT

Four subjects who had been existing on a controlled, adequate diet and who had been trained on the bicycle ergometer for from 9 months to 1 year were placed on a diet deficient principally in the vitamin B complex. During the 82 days on the deficient diet the subjects developed irritability, easy fatigability, lack of pep, anorexia, and increased leg pain during the work periods, but at no time did they develop any objective physical signs of vitamin B complex deficiency. The 24-hour urinary excretion of thiamine and riboflavin dropped to low levels.

Diets deficient in vitamin B complex in trained subjects decrease work output.

Early mild states of malnutrition, with no objective evidence of deficiency disease, do prevent maximal work efficiency.

Diets with about one-third (0.65 mg. of thiamine and 0.94 mg. of riboflavin) of the vitamin B complex of the recommended daily requirement do produce subjective symptoms of easy fatigue, irritability, lack of pep, anorexia, and increased leg pain during work periods, in spite of the fact that no objective evidence of deficiency disease is present.

The ratio of blood pyruvic acid to the total work output increases proportionately as diet deficiency progresses.

Subjective symptoms of fatigue irritability, lack of pep, anorexia and leg pains all disappeared and work output returned to normal or better within a few days following the supplementation of vitamin B complex.

Vitamin B complex supplementation added to a vitamin B complex inadequate diet restores work output to efficient levels.—Barborka, C. J.; Foltz, E. E.; and Ivy, A. C.: Relationship between vitamin B complex intake and work output in trained subjects. J. A. M. A. 122: 717-720, July 10, 1943.

G. PROCTOLOGY IN AN ADVANCE BASE HOSPITAL

EXPERIENCES AT U. S. NAVAL BASE HOSPITAL ———

JOHN D. CHARLES
Lieutenant (MC) U. S. N. R.

The proctologist in this hospital is a member of the general surgical staff and in addition to his other duties is called upon as necessity demands to render consultative service in cases requiring special proctologic studies. To the extent that proctologic cases are segregated and are attended by a trained proctologist, a service in proctology exists. Due to the relatively protected location of the organ, rectal war wounds were infrequent. Relatively few casualties with colonic wounds reached this hospital and those who did had undergone emergency laparotomy at a field station near the front.

The consultation service in proctology was sufficiently active to average one such examination per day; all patients received a proctosigmoidoscopic examination under conditions which, with the aid of a few improvisations, were considered adequate. Many of these patients were victims of dysentery and in several instances diagnosis of amebiasis were established by examination of direct smears and identification of trophozoites. Only three cases of rectal polypi were discovered; two of these patients were evacuated because of lack of proper instruments for adequate surgical treatment.

During a 6-month period, 89 surgical procedures were performed. Most numerous of these procedures were hemorrhoidectomies, totaling 41. These were done in a conventional manner, excising and suturing over a Buie-type clamp. Healing was not retarded by tropical conditions; the average postoperative stay, before discharge to duty, was 16 days. Many patients admitted with a diagnosis of hemorrhoids were promptly discharged, requiring no surgery. Most of these were examples of small external thrombotic hemorrhoids which had subsided sufficiently to make surgery unnecessary.

The next most frequent operation was the excision of infected pilonidal cysts; of these there were 32 cases. Except for two small cysts which were primarily sutured, and two which were partially closed with steel wire, all were widely excised, left open, and subsequently dressed daily together with the application of sulfathiazole powder. This type of dressing suppressed suppuration and speeded normal granulation. Only definitely infected cases were operated upon since

we felt it to be a distinct contraindication to operate upon men who could be at duty without hazard to their health in this vital theater of war. As a result, many patients with quiescent, uninfected cysts were returned immediately to duty without treatment.

Six fistulatomies were done, three of which were complicated by tortuous tracts and multiple openings. All of these responded well to conventional surgery, great care being exercised to incise through the internal fistulous opening. Seven cases of anal ulcer were treated by simple excision; all responded well. Only two patients with acute perirectal abscesses were seen during this period, probably due to the fact that incisions were done at a field hospital close to the front. There was one case of chronic postanal sinus. One patient with tuberculous infection of the anus with proved pulmonary lesion was seen; he was evacuated soon after admission.

The practice of proctology in an advance base hospital differs little from civilian practice among persons of a similar age group. In the tropics particularly, proctologic examination serves a valuable function as a diagnostic adjunct.



SULFATHIAZOLE IN ORAL SURGERY

The results of prophylactic use of powdered sulfathiazole locally were observed in 100 unselected routine cases of oral surgery. The patients were a heterogeneous group of male adults. Fifty patients received sulfa therapy and 50 were maintained as controls, receiving a saline mouthwash and acetylsalicylic sedation.

For controlling postoperative pain and infection in cases of slight trauma, sulfathiazole therapy is no better than the use of saline mouthwashes in conjunction with acetylsalicylic acid sedation. The incidence of complaints of postoperative discomfort and the rate of healing in both groups were approximately the same, the proportional differences being too small to warrant consideration.

Under conditions of excessive trauma, sulfathiazole therapy decidedly reduces the amount of postoperative pain and tenderness, as shown by the control group, and also greatly hastens the healing of tissues.

Not one case in the experimental group developed dry socket or other infection. One case in the control group did.

Because the amounts used and absorbed were small, in no case did a patient exhibit any untoward general reaction to the sulfa drug.—Helbraun, H. W.: Prophylactic use of sulfathiazole in oral surgery; a clinical study. *J. Am. Dent. A.* 30: 1197-1200, August 1, 1943.

H. WAR WOUNDS OF THE CHEST

A REPORT OF 278 CASES ENCOUNTERED AT
U. S. NAVAL BASE HOSPITAL ———

ALPHONSE McMAHON
Commander (MC) U. S. N. R.
and
HARRY R. HUSTON
Commander (MC) U. S. N. R.

Patients with chest wounds received at United States Naval Base Hospital ——— were treated by a surgeon and an internist working as a team. This unit was known as the Chest Wound Service and all patients with chest wounds, perforating or nonperforating, were referred to this service. The separation of these casualties in a ward apart from the general surgical casualties resulted in more efficient medical and nursing care, the latter of which constituted a most important part of the therapeutic regime. In no other hospital service, perhaps, is the teamwork between surgeon, internist, nurses, and hospital corpsmen more necessary. The efficiency of this cooperation will often decide the success or failure in the outcome of these casualties.

The grouping of chest wounds in one ward under a team service has other manifest advantages. The training of nurses and hospital corpsmen in the care of these cases is made possible by the fact that a large number of cases may be under observation at one time, which is not true where a scattering of cases exists. An adequately trained group of hospital corpsmen can more efficiently carry out standardized nursing procedures with a better knowledge of the underlying functional pathology and the progress to be expected in these cases. The surgeon and the internist under whose care these cases are placed are permitted a more extensive and specific diagnostic study of the clinical manifestations peculiar to this type of war wound. The information derived from these studies is of great benefit in establishing and evaluating therapeutic procedures.

The relative transiency of patients in this hospital interfered with the complete and satisfactory evaluation of plans of therapy in the majority of cases. Evacuation of patients who could not be returned to duty within a reasonable length of time became a matter of necessity, and the duration of observation of a case was always problematic and contingent upon the appearance of an evacuation ship. However, in spite of this apparent difficulty many cases were observed sufficiently long enough to establish the effectiveness of certain specific procedures.

CLASSIFICATION OF CHEST WOUNDS

In the classification of chest wounds, presented here as surgical casualties, have been included all cases in which the integument of the chest wall has been penetrated by any type of war missile. Cases of crushing injury to the chest and also concussion or blast injuries, which latter present an interesting phase of war injuries as related to the pulmonary structures, have been excluded from consideration at this time although both types of cases were observed and treated under the control of the Chest Wound Service.

It was not unusual to observe chest wounds occurring in conjunction with multiple body wounds, such as may result from shrapnel or machine-gun fire. The chest wounds were evaluated in relation to the other wounds of the body and were then treated in conjunction with staff members in other specialties who were called upon for assistance as indicated by the nature of the secondary wounds.

Chest wounds have been further classified into the perforating and nonperforating types. In the former group, with which this report will deal primarily, have been included those cases in which the continuity of the chest wall was disrupted by a war missile which produced pleural or pleuropulmonary damage. In the latter group are included all superficial injuries to the chest wall. These varied in extent and character with the nature of the missile and the application of the force. They may be far more damaging and serious in their ultimate effects than wounds of the perforating type.

LOCATION OF CHEST WOUNDS

The total number of patients presenting all types of chest wounds observed at this hospital over a period of 1 year was 278. Of this number, 81 or 29.8 percent, were of the perforating type. An analysis of the location of the wounds reveals that 101 wounds involved the anterior wall of the chest, 93 wounds were confined to the posterior wall, 32 wounds were located in the axillae. Wounds involving the shoulders proximal to the chest wall and producing damage to the chest wall occurred in 56 cases. Wounds of the neck resulting in chest complications occurred in 6 cases.

It was impossible, with any degree of accuracy, to elicit from the wounded men all facts pertinent to position of the wound in relation to the chest wall. The nature of the warfare was such that direct rifle and machine-gun fire on advancing troops was no more frequent in some actions than that delivered from hidden gun nests in lateral and rear positions. The men were unable to state definitely in many cases whether the wound was produced by rifle or machine-gun fire.

Shrapnel was not selective in any sense and the resultant wounds have borne out this fact. These were most commonly multiple. The

position of the man when wounded determined to some extent the location and type of wound. The character of the wound with possible resulting pleuropulmonary complications depended not alone upon the type of war missile but also upon the direction of the application of the force. It is beyond the scope of this report to attempt an analysis of all these factors. Numerous cases, however, were observed in which the less serious effect of the tangential application of the force of the missile was noted. The nature of the combatant activity was responsible to a large extent for the variety of wounds and the area of action from which casualties were derived determined in a great measure the character of the wounds.

PERFORATING WOUNDS OF THE CHEST

In this group were 81 cases. Six patients succumbed to the injury. All cases so classified presented either pleural or pleuropulmonary damage with such primary manifestations in the pleural cavity as pneumothorax, hemothorax, hemopneumothorax, or the secondary evidence of empyema and pleural effusion. Single wounds occurred in 62 cases, one of which was due to a bayonet. Multiple wounds, involving other areas of the body in addition to the chest, occurred in 18 cases.

The type of projectile determined to some extent the nature and the seriousness of the wounds. The size and speed of the missile and its relation to vital intrathoracic structures in its passage through the thorax were also important factors in the ultimate pathology produced. Shrapnel was responsible for 43 wounds; 3 succumbed to the injury. Rifle bullets produced wounds in 26 cases, 17 of which were anterior, 6 posterior, and 3 axillary. Three of the anterior wounds proved fatal. Machine-gun bullets caused 11 wounds, 6 of which were anterior and 5 posterior. Only one patient sustained a bayonet wound.

There was no constant relationship between the type of missile and the type of pleural or pleuropulmonary involvement. Fifty-five cases presented evidence of hemothorax, with bilateral involvement in five instances. Hemopneumothorax occurred in 20 cases, all of which were unilateral. Pneumothorax unaccompanied by immediate bleeding or serous effusion occurred in 6 cases, all of which were unilateral.

Through-and-through wounds of the chest occurred in 32 cases. In 28 there was resulting damage to pleura and lung. Four cases showed no serious pleural or pulmonary damage. In this latter group the missile was a small caliber high-velocity bullet. In the former group the wounds were caused by rifle bullets in 19 cases, by shrapnel in 6 cases, and by machine-gun bullets in 3 cases. Hemothorax occurred in 18 cases, hemopneumothorax in 9 cases, and pneumothorax in 1 case.

SYMPTOMS OF PERFORATING WOUNDS OF THE CHEST

The symptoms presented in each case depended on the nature of the wound and on the extent of damage produced by the missile in its passage through the structures of the thorax. The symptoms most commonly present were dyspnea, hemoptysis, cough, and pain in the chest.

Dyspnea occurred in over 70 percent of the cases. It was usually due to pulmonary compression although it was often present in cases with extensive pleural involvement in the absence of fluid in the pleural cavity. It was not uncommon to observe relatively large amounts of fluid in the pleural cavity with a minimal amount of dyspnea. The degree of dyspnea was influenced by the mobility of the mediastinum and the rapidity of the accumulation of the fluid within the pleural cavity. The majority of patients on arriving at this hospital had become adjusted to the cardiopulmonary factors of the primary shock so that the cardiac or circulatory element was not an important factor in the causation of the existing dyspnea. The symptom of pain which is discussed below sometimes played an important part in the respiratory embarrassment.

Hemoptysis was present in over 47 percent of the cases. The amount and duration of the bleeding varied with the individual case and there appeared to be no constant relationship between the extent of the injury and the degree of the hemoptysis. This symptom was absent in many cases in which the extent of external wound indicated apparent severe damage to the lung. Severe hemoptysis accompanied by hemothorax was, however, considered to be adequate evidence of more or less extensive pulmonary damage. Bleeding from the lung occurred immediately following the injury in the majority of cases. It was usually present to some degree on arrival at this hospital which took place in from 9 to 42 hours after the injury. The sputum was often merely blood-tinged; occasionally frank blood appeared in relatively large amounts. Fatal hemorrhage did not occur in any case. It was not always possible to obtain from the wounded men an accurate history as to the amount of the primary bleeding. Medical officers in the field of action undoubtedly possess more accurate information regarding this fact.

Cough was a common symptom following wounds of the chest, occurring in about 50 percent of the cases. It was not unexpected in view of the pleural or pleuropulmonary involvement. The degree and severity of cough varied, bearing some relation to the extent of the underlying pathology. In many cases it could be controlled only with great difficulty and proved to be a most harassing and troublesome, not to say dangerous, symptom. Persistent, poorly controlled

cough was responsible in some cases for continued hemoptysis. In performing thoracentesis for relief of intrapleural pressure, caution was exercised as to the amount of fluid removed, to avoid the pleural cough which might initiate fresh bleeding from pleural or pulmonary vessels.

Pain in the chest, either local or referred, was present in approximately 30 percent of the cases. It was considered as an important symptom only when sufficiently severe to cause the patient great discomfort. The pain accompanying the local wound in the chest wall was usually disregarded or minimized by the wounded man. It was controlled with minimal amounts of analgesics. The more severe chest pain was due to extensive pleural involvement accompanying large ragged wounds with great destruction to the chest wall. This pain was less easily controlled and presented a real problem in the treatment of the case. The continued pain reflected itself in the general physical and mental state of the patient and often interfered with the restoration of a normal mental attitude. The pain, when referred to surrounding areas such as phrenic nerve radiation to the neck and shoulder and to the upper abdomen along the course of the lower intercostal nerves, often become a matter of concern to both physician and patient and created additional diagnostic problems.

COMPLICATIONS

Pulmonary complications secondary to the initial wound were not numerous in the group under observation. Bronchopneumonia was observed in three cases, while pneumonitis occurred in two cases. Asthma was present in one case but had probably been present prior to the injury. The factor of age in these patients must be recognized as responsible to some extent for the low rate of pulmonary infections. The universal use of the sulfonamide compounds, however, has undoubtedly played a major part in the control of secondary infections. The value of these drugs may be attested to by the fact that in this series only one patient developed empyema while under observation. This case succumbed to multiple wounds. The "sucking wound" with open pneumothorax occurred in five cases. These cases presented no particular problem since the cardiopulmonary adjustment had been made before the patients were received at this hospital. All responded satisfactorily to surgical closure of the wound. One such patient succumbed, but death in this case was due to secondary renal failure. The excellent emergency treatment and care given these patients immediately subsequent to the injuries were unquestionably the determining factors in their ultimate recovery.

MORTALITY

In this series of 81 cases there were 6 deaths, a mortality rate of 7.4 percent. In all the cases terminating fatally there were multiple wounds, with serious organ damage, in some cases, in addition to the chest wounds. Hemothorax occurred in 5 cases and pneumothorax in 1 case; in the latter case empyema also developed. In 2 cases, the wounds were located in the neck. Both patients were wounded by rifle bullets which entered the lungs, producing in 1 case a "sucking wound." This patient, mentioned previously, ultimately died of secondary renal failure. The missiles in the remaining 4 cases penetrated the chest wall directly. It is impossible in this brief presentation to enter into the case reports in any great detail. A brief summary of the postmortem findings in the 6 cases ending fatally will provide some idea of the multiplicity and severity of the wounds.

CASE REPORTS

Case 1.—This patient was struck by fragments of metal. One entered the back at the level of the fourth thoracic vertebra and progressed downward and to the right, fracturing the fourth, fifth, sixth, seventh and eighth thoracic vertebrae and injuring the spinal cord at the level of the seventh vertebra. It entered the right pleural cavity, producing empyema and atelectasis of the right lung. There was also bronchopneumonia of the left lung with fibrinopurulent pleurisy. Another fragment entered the left upper arm fracturing the humerus. There was traumatic amputation of the left index and middle fingers and numerous lacerations of the skin.

Case 2.—This man received two gunshot wounds, a superficial one on the anterior surface of the right shoulder and a penetrating one just above the right clavicle in the middle third. The bullet causing this latter wound traversed the superior mediastinum and lodged in the tissues just to the left of the sixth cervical vertebra. It caused hemorrhage and edema of the superior and posterior mediastinum, fractures of the sixth and seventh cervical vertebrae and hemorrhage and edema of the spinal cord. There was massive atelectasis of the entire left lung and a portion of the right lung, with dilatation of the heart. There was also a dilatation of the bladder and bilateral hydro-ureter.

Case 3.—This man received a wound of the left chest, which fragmented the bones of the clavicle, the first rib and the manubrium of the sternum. There was a contusion and laceration of the lung with hemothorax. There was a congestion of the right lung. (Note: this patient died of renal failure with a total nonprotein nitrogen of the blood of 193.5 mg. per 100 cc.)

Case 4.—This man received multiple gunshot wounds. The bullet causing the major damage entered the body in the left lumbar region just below the twelfth rib. It penetrated the upper pole of the left kidney producing retroperitoneal hemorrhage. It tore through the spleen producing hemoperitoneum. It entered the thoracic cavity through the diaphragm and penetrated the lung, producing hemothorax and atelectasis. The bullet left the chest through the sixth rib on the left causing a fracture of that rib. It then entered the left upper arm, grazed the humerus and was found lying on the posterior surface of the humerus about the level of the axilla.

Case 5.—This man received two bullet wounds of the left chest. One entered the anterior wall between the fourth and fifth ribs. This pierced the anterior portion of the lung and continued through the left kidney causing hemothorax, retroperitoneal hemorrhage, necrosis and hemorrhage of the kidney, hemoperitoneum, thrombosis of the splenic vein and infarction of the spleen. The second bullet entered the left chest on the posterior wall between the eighth and ninth ribs, pierced the posterior portion of the lung, and made its exit from the thoracic cavity, between the eleventh and twelfth ribs, traversed the tissues posterior to the spine and left the body in the right lumbar region.

Case 6.—This patient received multiple shrapnel wounds of the left chest, left thigh and forehead. The piece of metal which entered the chest penetrated the diaphragm, the stomach and jejunum, producing hemothorax and hemoperitoneum and localized peritonitis. The wound of the thigh resulted in gas gangrene.

It is difficult, in establishing the cause of death in these cases, to evaluate the place of the chest wound in the multiple pathologic conditions present. The pathology present in the chest in these cases was hardly sufficient of itself to produce death, since by analogy similar cases with chest pathology uncomplicated by wounds of other organs underwent a normal convalescence. The absence of secondary infection, with one exception, in those cases with intrapleural hemorrhage, is a conspicuous fact.

TREATMENT

The policy as regards surgical intervention in these cases was essentially one of strict conservatism. Surgical treatment was minimal and was confined chiefly to local care of the wounds, debridement, the removal of superficial foreign bodies and the closure of pleural wounds. The damaged pleural and pulmonary tissues were otherwise left untouched except for thoracentesis, which was performed only for the relief of intrathoracic pressure symptoms. Foreign bodies in the lung were not disturbed and no secondary pathologic changes were observed in the lung from metallic fragments while the patients remained in this hospital.

Thoracentesis for hemothorax or pleural effusion was performed 24 times in 16 patients. It was necessary to remove blood from the pleural cavity on 4 occasions in 1 patient. The mere presence of blood within the pleural cavity produced no ill effects. The duration of the stay was seldom sufficiently long to observe complete absorption in cases with a large hemothorax. Many cases with smaller amounts of blood showed complete absorption in from 2 to 3 weeks.

The treatment in these cases resolved itself largely into the application of medical supportive measures. Rest, both mental and physical, was considered absolutely essential in the care of these wounded men. Every effort was made to disturb the patient as little as possible. All nonessential nursing procedures were eliminated during the first few days of their hospitalization and were resumed only when justified by

the returning strength of the patient. Morphine was used freely to relieve pain and thus indirectly to prevent secondary shock. It was also used to secure rest in cases with persistent pulmonary bleeding. There were no ill-effects observed from the rather free use of this drug. The combination of hypnotics and morphine proved very effective in securing adequate rest for the patient. The hypnotic was continued as long as the patient seemed apprehensive or restless.

Diet constituted no particular problem, for almost all of these patients had a normal appetite after the first few days in the hospital. An attempt was made to maintain a high caloric intake in all cases in order to restore weight and to arrive at a normal energy balance in as short a time as possible.

The food was supplemented by liberal amounts of vitamins given chiefly in the form of a multiple vitamin compound. Thiamine hydrochloride was added in doses of 5,000 to 10,000 units daily for purposes of rapid replacement. The return of appetite and the improvement in general health were often very striking under this regime.

The degree of anemia reached serious levels in some cases. The average red blood cell count in the perforating chest wounds was 3,200,000. The hemoglobin averaged 65.7 percent. When marked, the anemia was treated by transfusions of whole blood and by the oral administration of iron in the form of ferrous sulfate. A total of 21 transfusions were given to 19 patients. The response of the anemia in the other cases to the simple measures of adequate food and iron therapy was in most cases very gratifying. In cases with satisfactory red blood cell counts requiring fluid replacement alone, 1 or 2 plasma transfusions were entirely adequate.

Sulfathiazole was administered to all patients with chest wounds immediately upon admission to the hospital. The drug had been given to the patients from the time of the injury, but in order to assure an adequate concentration in the blood each patient was given 1 gm. of sulfathiazole every 4 hours for 3 days. The dose was then reduced to 1 gm. four times a day for an additional 4 to 7 days. If the factor of infection was considered minimal, the drug was then discontinued. There were no untoward reactions to the drug. The crystals of the drug were found in the urine in only six cases. This plan of therapy seemed to exert a highly satisfactory effect in the control of pleural and pleural pulmonary infections.

CONCLUSIONS

Of a total of 278 patients with war wounds of the chest admitted to United States Naval Base Hospital — during the first year of its operation, 29.8 percent had wounds which perforated the chest wall. There were six deaths among those with perforating wounds which gave a mortality rate of 7.4 percent. All patients who

died sustained multiple wounds in other areas of the body. The limitation of surgical intervention in these cases is believed to have been an important factor in the low mortality rate. General medical supportive treatment seemed to be the most important part of the care of these patients. The application of a strictly conservative policy gave highly satisfactory results and is recommended for the management of this type of case. The skillful primary care of chest wounds in the hands of the field surgeon and the use of the sulfonamide drugs were responsible for the excellent condition in which these patients were received at this hospital and also for the ultimate favorable outcome in a high proportion of these cases.



CISTERNAL PUNCTURE IN TRAUMATIC SHOCK

The main feature of the final stage of traumatic shock is a considerable reduction in tonus of the sympathetic nervous system and a partial increase in that of the parasympathetic nervous system.

The most effective means of combating shock in this final stage is the raising of the tonus of sympathetic nerve centres by the direct action on those centres of potassium ions.

If potassium phosphate be introduced directly into the lateral ventricles or cisterna magna, the potassium ions will stimulate sympathetic nerve centres and the phosphate (reducing the concentration of ionised calcium) will cause a depression of parasympathetic centre tone.

This measure is indicated in traumatic shock in the phase of decreased sympathetic tonus, that is at a comparatively late stage. In no circumstances should it be employed when there is evidence of sympathetic excitation, as sometimes happens in the first phase of shock.

It is effective in man, as well as in experimentally produced shock in animals. In human cases, it must be introduced into the lateral ventricle or cisterna magna to be effective; 1-2 c. cm. of a one-sixth molar solution of a mixture of potassium hydrogen phosphate and potassium dihydrogen phosphate, pH 7.6, is injected with the patient lying horizontally on the left side with the head at a lower level than the body.

Other measures of combating shock, such as transfusion and alleviation of pain, should not be neglected.—Stern, L. S.: Shock: Treatment by direct action on vegetative nerve centres. *Lancet* 2: 572-573, November 14, 1942.

I. EXPERIENCES WITH MALARIA AT AN ADVANCE BASE IN THE SOUTH PACIFIC

A REPORT OF 4,647 ADMISSIONS AT ———

WALTER M. SIMPSON
Captain (MC) U. S. N. R.

WILLIAM H. LEAKE
Commander (MC) U. S. N. R.

ALPHONSE MCMAHON
Commander (MC) U. S. N. R.

THOMAS V. GUDEX
Lieutenant Commander (MC) U. S. N. R.
and

RAY R. RUECKERT
Lieutenant (MC) U. S. N. R.

When the medical officers comprising the staff of United States Naval Base Hospital — sailed from the United States assigned to the mission of establishing the first United States naval hospital in the South Pacific area, it was with the knowledge that the advance base which was to be their destination was situated in the midst of one of the most heavily malarialized areas in the world. It was also known that for some providential and as yet unknown reason, many of the other islands of the Pacific, such as New Caledonia, the Loyalty Islands, the Gilbert and Ellice Islands, the Society Islands, Hawaii, Samoa, Tonga, and Fiji, are malaria-free, since anopheline mosquitoes are absent on these islands. By contrast, the islands of the New Hebrides, the Solomons, and those to the north and west of these groups harbor malaria in hyperendemic intensity. In these heavily infested island groups have occurred some of the greatest concentrations of United States forces during the present war.

Realizing that malaria would undoubtedly constitute the paramount medical problem, an organized series of lectures dealing with this and other tropical diseases was carried out on the transport vessel during the outbound voyage. The need for this preparation was immediately manifest upon arrival at the destination. A high proportion of the force which had occupied the island a few weeks previously, were already victims of malaria. Large numbers of officers and enlisted men were being admitted to the sick list daily with the disease and steps were taken immediately to utilize available buildings as a temporary hospital, pending the construction of the base hospital.

On the day following disembarkation, the Force Surgeon appointed

a Mosquito Control Commission, with one of us (W. M. S.) as President. Immediate steps were taken to conduct a complete survey of the island in order to determine the location of anopheline breeding areas, and to initiate the necessary engineering programs for their ultimate elimination. In July 1942, these functions were assumed and expanded by the Malaria Control Unit, under the direction of Commander J. J. Sapero (MC) U. S. Navy. The effectiveness of the malaria control program on this base is reflected in the remarkably progressive decline in the malaria rate. Even during the recently terminated rainy season, the rate of incidence exhibited a steady decrease. (See article K in this series entitled "Malaria Control Program at a South Pacific Base.")

It was soon observed that in a high proportion of cases the disease assumed a more severe form than that ordinarily observed in the United States, and required more intensive and prolonged treatment. Because of the frequency with which the onset symptoms and signs of malaria simulated surgical or other medical conditions, thick blood films were made routinely on all patients immediately upon admission to the hospital. In a surprising number of instances plasmodia were demonstrated in patients who did not exhibit typical symptoms of malaria. No patient admitted primarily to this hospital was treated for malaria unless plasmodia were found in blood films. Deviation from this rule was necessary in those cases in which the diagnosis had been established elsewhere just prior to admission at this hospital and in which antimalarial therapy had been started. Without doubt, many patients in whose blood films plasmodia were found, in the absence of characteristic clinical symptoms, had latent malaria. Such patients were given the usual course of antimalarial therapy.

During the first year of occupation of this island there were 3,767 admissions for malaria among the United States military and naval personnel attached to activities on this island base. Of these, 2,537 represented original admissions, 786 were first admissions, and 444 were admitted 3 or more times. In addition, 880 patients from other bases, chiefly from Base ———, either had malaria on admission to this hospital or developed it during their period of hospitalization for some other condition.

Thus, there was a total of 4,647 admissions for malaria, involving 3,417 individuals. There were 2,064 admissions for malaria to United States Naval Base Hospital ———, while the remainder were admitted to outlying naval sickbays and Army aid stations and hospitals on other parts of the island.

Of the 2,064 admissions to this hospital for malaria, the diagnosis was first established by the demonstration of plasmodia in blood smears in the laboratory of this hospital in 1,184 instances. In the remaining cases, the diagnosis was made elsewhere before the patient was ad-

mitted to this hospital, and in most instances the patient had received some antimalarial therapy prior to admission. Hence, only the records of the 1,184 patients whose diagnosis was established unequivocally at this hospital were reviewed and subjected to statistical analysis. An attempt was made to correlate the severity of symptoms, the presence of complications, and the response to treatment with the species of plasmodia involved. The information obtained from the analysis of these cases is summarized in table 1. For the purpose of this study the cases were first divided into two classes: (1) "Ordinary" cases, signifying those patients who responded promptly to one routine course of therapy, and (2) "refractory" cases, indicating those patients who failed to have a satisfactory response to one or more courses of therapy.

TABLE 1.—*Résumé of symptoms, complications, and treatment*

	Ordinary cases				Refractory cases			
	P. vivax	P. falcip.	Undet.	Quartan	P. vivax	P. falcip.	Undet.	Quartan
Severity of symptoms:								
Mild.....	274	147	245	3	28	27	15	
Moderate.....	121	117	124		15	26	8	
Severe.....	6	9	5		0	8	2	
Proved:								
1.....	50	27	50	1	10	13	11	
2.....	26	18	16		7	13	3	
3.....	12	5	5		9	6	3	
4.....	9	4			4			
5.....	2	1	1			1		
6.....					1			
Previous attacks—unproved:								
1.....	24	12	18	1	1	5	4	
2.....	30	19	17		2	3		
3.....	8	10	14		3	4		
4.....	6	5	9		1			
5.....	3	1	1					
6.....	1	2	4					
Number of smears necessary to get a positive smear:								
1.....	262	163	141	2	26	36	11	1
2.....	22	27	27		5	11		
3.....	11	3	8		4	1	3	1
4.....	2	3	4		1	2		
5.....	2				1	2		
Persistent gametocytes	0	18	1		3	26	4	1
Palpable spleen.....	66	60	41	1	15	17	1	
Palpable liver.....	7	3	1		1	1	1	
Complications:								
Anemia:								
Under 3.5.....	18	36	19		7	7	2	
Under 3.0.....	12	18	4		1	9	2	
Jaundice:								
Before.....	1	2	2		1	1	1	
During.....	3	2	11		1	1	2	
After.....			2					
Cerebral (albuminuria and casts).....			2			1	1	
Regular prophylaxis (suppressive therapy).....	160	130	118	3	28	31	11	1
Parenteral therapy:								
Intramuscular atabrin.....	4	7	1	1	1	6		1
Intramuscular quinine.....	2	5	5		1	1		
Intramuscular mapharsen.....	6		2			2		1

¹ 1 case had mixed *P. vivax* and *P. falciparum* infestation.

² 3 cases had mixed *P. vivax* and *P. falciparum* infestation.

ANALYSIS OF TABLE 1

Of the 1,184 cases studied statistically, 1,051, or 88 percent were classed as being of ordinary severity, signifying that there was a prompt response to one course of therapy as evidenced by subsequent negative smears. There were 133 refractory patients, or 12 percent of the total number, all of whom required 2 or more courses of therapy before the clinical symptoms of malaria disappeared and the blood smears no longer revealed the presence of parasites.

Ordinary cases.—Of the 1,051 ordinary cases, 38.1 percent had smears positive for *P. vivax*, 25.9 percent for *P. falciparum*, 35.5 percent had plasmodia the type of which could not be determined, and the remaining 1 percent were *P. malariae*. In explanation of this apparently high proportion of smears in which a species diagnosis could not be made, it should be pointed out that the great majority of patients with malaria were admitted immediately after the first paroxysm. In a large percentage of such early cases, trophozoites are immature, infrequent and fail to reveal typical species characteristics. In general, the symptoms were milder in those patients whose smears were positive for *P. vivax*. Of a total of 401 cases with smears positive for *P. vivax*, 24.6 percent of those treated at this hospital had proved recurrent attacks or additional attacks due to reinfection. Among the 273 cases with smears positive for *P. falciparum*, 20 percent had proved reinfection or recurrence. Without doubt an indeterminate, but undoubtedly high proportion of our malaria patients subsequently developed recurrent malaria after evacuation to a nonmalarious area, or were readmitted to another medical activity on this or some other base. In the great majority of instances the smears were found to be positive on the first examination. However, in an appreciable proportion of cases, as many as three to five smears, usually made at daily intervals, were necessary in order to find the plasmodia. Persistent gametocytes were present in 19 cases, and of these 18 were classified as *P. falciparum*. In the remaining instance the species could not be determined. A palpable spleen was noted in 15.9 percent of the cases of ordinary severity. Anemia (less than 3,500,000 red blood cells per cu. mm.) was present in 7.4 percent of the cases infected with *P. vivax* and in 19.7 percent of the cases infected with *P. falciparum*. Jaundice was an infrequent complication, occurring in only 1 percent of cases caused by either *P. vivax* or *P. falciparum*. In this series 38.8 percent of the patients gave a history of having received regularly administered atabrin or quinine suppressive therapy for more than 1 month previous to the onset of symptoms of malaria. There were 12 cases which exhibited signs of definite cerebral involvement.

TABLE 2.

1. Refractory cases (with clinical symptoms) :	
A. Recrudescence while under treatment.....	9
B. Recrudescence during convalescence in hospital.....	14
C. Recrudescence during prophylaxis (within 1 month of discharge).....	5
2. Refractory cases (persistence of parasites but without symptoms) :	
A. While under treatment.....	15
B. During convalescence in hospital.....	4
C. Recrudescence during prophylaxis (within 1 month of discharge).....	5

Refractory cases.—Of the total number of cases studied, 133, or 15 percent, were refractory in their response to one or more courses of routine therapy (table 2). In 42.1 percent, positive smears were obtained during the period of active treatment, and in 57.9 percent they were obtained while the patient was on a program of routine suppressive therapy which in most instances consisted of atabrin, gr. 3, twice weekly.

In table 1 it is shown that of the total of 133 refractory cases, 32.3 percent had smears positive for *P. vivax*, 45.9 percent for *P. falciparum*, 18.9 percent plasmodia of undetermined species, and 2.4 percent for *P. malariae*. In the series of refractory cases, those due to *P. falciparum* had definitely more severe symptoms than those due to *P. vivax*. However, the tendency for recurrent attacks was essentially the same for both species. As in the cases of ordinary severity the majority of smears were found to be positive on the first examination. Persistent gametocytes were present in 29 cases and of these 26 cases were classified as *P. falciparum*. A palpable spleen was found to be present in 20.7 percent of these cases. Anemia was present in 10.8 percent of those cases infected with *P. vivax*, and 26.2 percent of those infected with *P. falciparum*. A history of continuous suppressive therapy was obtained in 52.6 percent of the patients in this series. It was necessary to use parenteral atabrin or quinine therapy in 7.5 percent of these patients in order to obtain a satisfactory clinical response.

SUMMARY OF FINDINGS

From the above analysis of ordinary and refractory cases it is evident that the symptomatology is more severe when *P. falciparum* is the causative agent. There was a slightly greater tendency for recurrent attacks in those cases due to *P. vivax*. Persistent gametocytes overwhelmingly existed in both the ordinary and the refractory cases which were due to *P. falciparum*. There was no appreciable difference in the incidence of a palpable spleen as regards the species of plasmodia. A much greater tendency toward anemia was noted in both ordinary and refractory cases which were due to *P. falciparum*.

In the total of 4,647 admissions (3,417 cases) of malaria encountered at this base only 1 death occurred. There was only 1 case of blackwater fever; this patient recovered. The patient who died had a blood smear positive for plasmodia (species undetermined), but the malaria was complicated by postvaccinal hepatitis and jaundice (yellow fever vaccine). All of the 12 patients with cerebral malaria recovered. (These cases are described in the following paper.)

One explanation for the low mortality rate and the infrequency of cerebral malaria or blackwater fever may be that there is a high degree of malaria-consciousness at this base. Consequently, patients are usually brought to the hospital immediately after the first symptoms develop. Thick blood smears are made immediately upon admission and, if positive, the treatment program is begun promptly.

TREATMENT

Suppressive therapy (prophylaxis).—During the first few weeks following the establishment of this base, quinine, in daily doses of 10 gr., was used for suppressive therapy. With the exception of this early period, and in the very small number of persons who were apparently intolerant to atabrin, the suppression program has been carried out with a standard dosage of atabrin, gr. 3, given twice weekly. This dosage of atabrin was selected with the hope of establishing a sufficiently high blood level of the drug to counteract sub-clinical intensity of parasites. As shown in the analysis of the cases studied, less than 50 percent of the patients with malaria gave a history of consistently following out the prescribed program. Most of this discrepancy was due to the distribution of troops to outposts, or to front line positions where it was impossible for the respective medical officers adequately to supervise the administration of the drug. It was soon found that the responsibility for the taking of this medication could not be left to the individual. Even in well-supervised aid-stations, sickbays, and hospital wards it was necessary to have attendants actually observe the swallowing of the tablets. Many instances were brought to light where individuals disposed of the tablets by placing them in their pockets, underneath bedding, throwing them into toilets or on the ground. The occurrence of symptomatic malaria in nearly 50 percent of the cases in this series, in which there was reasonable certainty that the prescribed medication had been taken regularly, would indicate that neither atabrin nor quinine uniformly suppressed the clinical symptoms of the disease.

Active treatment.—During approximately the first half-year of the operation of this base, many varying courses and combinations of the antimalarial drugs were experimented with in the hope of finding an optimal program for the active treatment of this disease in

this area. No appreciable difference was noted in the effectiveness of courses of atabrin, gr. $4\frac{1}{2}$, given daily for 7 days, and courses of quinine, gr. 30 to 60, given daily for 7 days, or in the combination of 1 week of quinine therapy followed by 1 week of atabrin therapy.

During the past 6 months the plan of antimalarial therapy utilized at this hospital has been an adaptation of the so-called "combined Q. A. P. treatment." This program has yielded the best results. For the first 3 days a daily dosage of quinine hydrochloride, gr. 30, together with atabrin, gr. $4\frac{1}{2}$, is given orally, in divided doses, three times daily. This is then followed by atabrin, gr. $4\frac{1}{2}$, daily for 4 more days. The addition of quinine to the first 3 days of a 7-day course of atabrin therapy was found to control the symptoms more effectively and reduce the incidence of paroxysms than when atabrin was used alone. In most instances one paroxysm was aborted by combining the two drugs for the first 3 days. No untoward reactions occurred as a result of combining the two drugs for this short period. It has been found that in cases complicated by vomiting at the beginning of the illness, the intramuscular injection of atabrin, in doses of gr. 3, twice daily for 1 or 2 days, produced a prompt amelioration of symptoms, after which the patient was continued on oral therapy. Quinine was given orally in solution and the actual swallowing of all antimalarials was observed by an attendant.

In those cases in which sexual forms of the parasite were found to persist, a course of plasmochin was also administered. This drug was found to be most effective when given in the following manner: After discontinuing all antimalarial therapy for 2 days, quinine hydrochloride, gr. 10, daily for 5 days, was administered concurrently with plasmochin, gr. $\frac{1}{3}$, twice daily for 2 days, followed by plasmochin, gr. $\frac{1}{3}$, once a day for 3 days. The earlier use of a course of plasmochin, gr. $\frac{1}{3}$, twice daily for 5 days, was found to cause 25 percent of the patients to exhibit such toxic symptoms as nausea, vomiting, epigastric cramping, and cyanosis on the fourth or fifth day of the course. No serious consequences resulted. These symptoms of toxicity were transitory.

The use of quinine intravenously was limited almost entirely to those cases showing evidence of cerebral involvement.

It is important to record that among the many thousands of persons who have received repeated doses of atabrin, either prophylactically or therapeutically, no significant toxic reactions have been observed. Liver function tests have revealed no evidence of damage to this organ resulting from the long-continued administration of atabrin.

CONCLUSIONS

At this South Pacific base, malaria due to *P. vivax* was more prevalent in cases of ordinary severity, while *P. falciparum* infection was more prevalent in the refractory cases.

2. In general, the symptoms were milder in the cases due to *P. vivax*.

3. Patients with *P. vivax* infection showed only a slightly greater tendency to have proved recurrent attacks than those with *P. falciparum* infections.

4. Persistent gametocytes were present overwhelmingly in cases due to *P. falciparum*.

5. Anemia was a more frequent complication in cases due to *P. falciparum*. Jaundice was a rare complication, occurring in only 1 percent of cases.

6. There were 133 therapeutically refractory cases of malaria, an incidence of 12 percent.

7. The majority of the refractory cases were due to *P. falciparum*.

8. Only one death occurred among the 4,647 admissions (3,417 cases) of malaria encountered at this base. This case was complicated by postvaccinal hepatitis (following vaccination against yellow fever).

9. There was only one instance of blackwater fever and 12 patients had cerebral malaria. All recovered.

10. Of 1,184 cases subjected to critical analysis 88 percent showed negative smears after one course of therapy with quinine, atabrin, or the combination of both agencies.

11. The effectiveness of the malaria control measures which have been carried out at this base is demonstrated by the progressive decline in the month-to-month rate of incidence.



NITROGEN EQUILIBRIUM

Amino acid solutions intravenously administered in sufficient quantities have been shown in one instance to maintain positive nitrogen balance.

In certain patients injections of intravenous amino acids are followed by increases in serum proteins.

Solutions of amino acids given intravenously appear to be of value in relieving intractable anorexia.—Messinger, W. J.: Nitrogen equilibrium and regeneration of serum protein. *Arch. Int. Med.* 72: 91-103, July 1943.

J. CEREBRAL MALARIA

A REPORT OF 12 CASES ENCOUNTERED AT U. S.
NAVAL BASE HOSPITAL —

WALTER M. SIMPSON

Captain (MC) U. S. N. R.

and

JAMES L. SAGEBIEL

Lieutenant Commander (MC) U. S. N. R.

At any time during an attack of malignant tertian malaria grave complications involving the central nervous system arise. *Plasmodium falciparum*, which is almost without exception the invading organism, chooses no special part of the neuraxis; cerebrum, cerebellum, brain stem, cord and meninges suffer impartially with peripheral nerves and the autonomic nervous system. In the more acute and overwhelming infections all divisions of the central and peripheral nervous systems may be involved simultaneously.

In assembling the data on the 12 cases on which this presentation is based no attempt was made to include all types of malarial invasion of the nervous system. Some cases have been encountered in which a psychosis or psychoneurosis seemed intimately related to an attack of malaria. These have not been included in this study since it is probable that the occurrence of malaria in the psychotic or psychoneurotic individuals was purely coincidental. The 12 cases which provide the subject matter of this communication constitute examples of the more severe and acute forms of cerebral malaria. Seven of these patients went through the entire course of their illness in this hospital while the other 5 patients were received here after the acute stage had more or less subsided.

It has been stated that malignant tertian malaria pursues an entirely different course from those forms of malaria caused by *Plasmodium vivax* or *Plasmodium malariae* and that this is due to certain fundamental differences in the behavior of *Plasmodium falciparum* in the human host. In the first place, *P. falciparum* is markedly invasive. There is an extraordinarily rapid and great increase in the number of parasites in the blood stream. Therefore the amount of debris and foreign protein released into the circulation at sporulation time is greatly increased. Secondly, internal sporulation occurs for the most part in the capillary systems of certain of the viscera. Large numbers of parasites block the capillaries and are aided in forming cohesive emboli by the agglutinative traits of

parasitized erythrocytes together with their tendency to adhere to the vascular walls. Thirdly, *P. falciparum* sporulates asynchronously; this explains the unusual and irregular febrile reactions.

PATHOLOGY

The pathologic physiology of cerebral malaria is essentially that of capillary occlusion which occurs secondarily as the result of widespread changes in the blood and circulation during schizogony. The blood changes include an increase of euglobulin, a rise in the blood cholesterol, lecithin and glucose during the chill, a great increase of blood potassium due to rupture of red cells, stimulation of erythropoiesis and activation of the reticulo-endothelial system. As the parasite population of the blood rises blockage of capillaries in various organs occurs and this, together with the toxic products of the infection, causes a disturbance of the circulation. Tissue respiration and nutrition are affected. The liver and kidneys suffer from the heavy demands upon their functions. The adrenal glands show cortical depletion, probably due to potassium poisoning. The heart shows toxic changes and is further embarrassed by the blood changes and by the effects of the disease on other organs.

In the presence of these profound blood and circulatory changes and with the parasite concentration in the blood rising, agglutination of parasitized red cells in the brain capillaries occurs; these clumps adhere to the vascular walls and thus cause embolic occlusions. With the occlusion, an ischemia of the brain tissue served by the capillary develops and focal necrosis (infarction) occurs. At first in the acute stage it is perivascular and associated with minute ring hemorrhages. Soon, however, malarial granulomas consisting of glial cells appear and more distant degeneration of the nerve cells occurs. The clinical picture of cerebral malaria is, consequently, determined by the location and extent of such areas of damaged brain tissue. If the damage occurs in the motor cortex or internal capsule, monoplegia or hemiplegia results; if in Broca's convolution, aphasia results; if in the cerebellum, the development of ataxia, asynergia and nystagmus produces the typical cerebellar syndrome.

Grossly the brain presents a gray or grayish brown appearance and is relatively dry. Hyperemia is generally prominent throughout the neuraxis with punctate hemorrhage in the white matter, seldom in the gray. Linear or globular extravasations occur but large effusions are rare. Minute areas of infarction and softening are frequently encountered.

The histologic picture is primarily one of intense mesenchymal hyperplasia. Blood vessels are engorged and numerous capillaries are plugged or partially plugged with parasitized red cells, lympho-

cytes and clumps of pigment. The endothelium swells and proliferates and through this damaged wall diapedesis occurs. Perivascular monocytic reactions are not uncommon. To this tissue insult the neuroglia respond in their usual fashion by cleaning up the debris and repairing the damage. Throughout the parenchyma are noted ganglion cells in all stages of degeneration.

SYMPTOMS

One dominant symptom appeared in 9 of the 12 cases. This was the sudden onset of epileptiform convulsions and coma. The convulsions were generalized and of a major motor type with extensor tonus, rotation of the head, conjugate rolling up of the eye, rhythmic clonic movements, cyanosis, frothing, and tongue-biting. Status epilepticus was common, the patient having periodic seizures without regaining consciousness. Sometimes multiple minor motor or focal attacks would be inserted between the major convulsions. One case presented the clinical picture of decerebrate rigidity with continuous extensor tonus, showers of fine tremors and periodic convulsions, and bilateral Babinski phenomena.

The coma which these cases presented varied from semistupor with purposeless motor movements to profound shock with cold, clammy skin, weak, thready pulse, Cheyne-Stokes respiration, and complete lack of response to all stimuli. Three of the nine cases developed coma without convulsions, from which they gradually emerged under appropriate therapy.

Four of the nine had signs and symptoms of meningitis; the most outstanding one being neck rigidity even with the patient in an unconscious state. Photophobia and headache were usually present.

An acute confusional psychosis developed in six of the nine cases. Its duration was variable, lasting from 2 to 12 days and, as is characteristic of organic confusional states, it was frequently punctuated by lucid intervals. Many times, the change from lucidity to confusion was rapid and would occur during the course of a 10-minute conversation. The chief characteristic of the abnormal mental reactions in these cases were: (1) Alternating lucid and confusional periods; (2) increased psychomotor activity sometimes to the point of violence; (3) negativism varying from refusal to obey simple commands to combativeness; (4) complete disorientation; (5) visual hallucinations; and (6) psychic and motor irritability. After the acute stage had passed into early convalescence it was noted that easy mental fatigability was a prominent feature. During a short conversation, the patient, at first mentally clear and answering correctly, would begin to ramble, make irrelevant remarks, and become quite irritated at his inability to retain control over a damaged brain and psyche.

All of the patients regained complete mental and emotional normality and on discharge no defects were noted. One of the cases, during the acute stage, developed a mild transient hemiparesis while another manifested a cerebellar syndrome with weakness, ataxia, and dysmetria of the extremities.

FEVER

The febrile reactions were highly irregular, as is characteristic of the pernicious type of *P. falciparum* infestation. There was no tendency to follow a regular 48-hour cycle. A peak was usually reached daily and there were wide fluctuations during the course of a day. Some of the temperature levels fell by lysis but most of them by crisis following intravenous quinine therapy. Once having attained normal temperature they tended to stay at this level.

SPINAL FLUID FINDINGS

In the eight cases in which the spinal fluid was examined it was found to be clear and colorless but always under moderately increased pressure. A pleocytosis was present in those cases manifesting the most marked meningeal symptoms and signs. This varied from 30 to 165 cells. In several cases removal of 25 to 30 cc. of spinal fluid resulted in prompt clinical improvement, being especially noticeable in relieving the intense headaches from which most suffered.

In the series of 12 cases, two-thirds developed rapidly progressive anemia which responded well during convalescence to iron therapy. One-fourth developed a transient acute nephritis, usually of a hemorrhagic type and one-fourth had associated abdominal symptoms. One patient exhibited vasomotor instability during the first 10 days after he became afebrile, having a bradycardia of 50 to 55 in the morning which would rise to 70 to 80 in the evening. Another, who was epileptic in childhood, and who had the coma-convulsion type of cerebral malaria, continued to have epileptic seizures twice a week for 3 weeks.

The other three cases of this series which do not come under the coma-convulsion type will be mentioned briefly, mainly to illustrate the diversity of neurological syndromes which may be caused by cerebral malaria.

The first patient developed an acute confusional state with the onset of chills and fever and was quite irrational, noisy, and violent for 4 days. This was superseded by stupor, negativism, and dysarthria. As the mental symptoms subsided he developed diplopia, a divergent squint of the left eye, inability to converge the eyes, an unsteady gait, and generalized ataxia. All these symptoms gradually disappeared, the dysarthria being the last to go. These symptoms indicated localization in the midbrain, with involvement of the oculomotor and vagal nuclei and the superior cerebellar peduncles.

The second patient had developed the usual symptoms of a concussion syndrome following a bombing attack a week previously. For 3 days before and 3 days after entry he complained of stiffness and pain in the neck. His temperature was 100° to 102° F. He had vague pains in his right shoulder and left leg and a Babinski reaction on the right side. His white blood cell count was 4,500 and the tip of the spleen was palpable and tender. A spinal puncture gave negative results but gave him marked relief from headache and pain in the neck. On the fourth day his temperature suddenly rose to 105.6° F. and he complained of weakness and heaviness of both legs, double vision and somnolence. *P. falciparum* were found in blood smears. The deep reflexes were lost, superficial sensation became diminished in his legs and there was impaired conjugate deviation to the right with paresis of upward gaze, unequal pupils, and some oculomotor weakness. Following intravenous quinine therapy he made an uneventful convalescence and continued to have negative malaria smears for the next 2 months. Two months after his initial infection he began to complain of anorexia, nausea, vomiting, malaise and abdominal cramps, pain over the left eye, stiffness of the neck, drowsiness and an increase in the diplopia. After two attempts, *P. falciparum* in a 1-plus concentration were found in blood films. Routine oral quinine, atabrin, and plasmochin treatment caused a rapid amelioration of his symptoms. This case also had midbrain localization and in addition there was evidence of basilar meningitis in the region of the interpeduncular space.

The third case was one presenting moderate weakness and ataxia of the left leg and both upper extremities in the presence of normal reflexes and normal sensation. Photophobia was present but there was no neck rigidity. He complained of severe headache and pain in the eyes. The temperature had gradually risen over 3 days to 105° F. Blood films showed heavy *P. falciparum* infestation. With intravenous quinine the temperature promptly fell to normal and his cerebellar and meningeal symptoms disappeared.

PROGNOSIS

The prognosis in cases of cerebral malaria depends upon a number of factors, the most important of which are early diagnosis and prompt and intensive intravenous chemotherapy. The general condition of the patient is important since marked loss of weight or intercurrent disease renders the outlook more unfavorable. Stitt mentions the accepted mortality in cerebral malaria to be 25 to 50 percent even with treatment. Thomas and Sydenstricker reported a mortality of 50.6 percent in cases of cerebral malaria. In more recent years, with prompt and energetic treatment their mortality figure has fallen to 11.8 percent in 76 cases. In the present series there were no deaths. None of our patients had any residual neurologic or psychiatric sequelae when evacuated. It has been the policy at this hospital to evacuate all patients who have had cerebral malaria on the grounds that reinfection with *P. falciparum* might have disastrous consequences.

TREATMENT

The development of cerebral malaria constitutes a grave threat to life and demands immediate, continuous, and intelligent action by medical officers, nurses, and hospital corpsmen. It is as much of an emergency situation as the acute onset of diabetic coma. The treatment of choice in cases of cerebral malaria consists of injecting quinine dihydrochloride intravenously, promptly, and in adequate dosage. The program employed at this hospital at the present time consists of injecting intravenously, during a period of no less than 30 minutes, $7\frac{1}{2}$ gr. of quinine dihydrochloride in 250 cc. of normal saline solution. This dosage should be repeated at intervals of 8 hours until the patient's symptoms are sufficiently alleviated to permit him to take quinine (preferably in solution) by mouth, in doses of 30 gr. daily for 1 week.

In most instances, the response is striking and dramatic. A comatose patient who has been having repeated convulsions usually becomes essentially normal in 12 to 24 hours. Mental confusion is usually present for a few days after the patient has regained consciousness. In treating the first few cases, larger doses of quinine dihydrochloride, that is, 15 gr. in 500 cc. of normal saline solution, were used. It was soon felt that such doses approach the danger line too closely. Two patients who received two and three such injections, respectively, developed transient signs of possible toxic delirium. It is better not to exceed $7\frac{1}{2}$ gr. in any one dose and then to repeat this dosage at intervals of 8 hours if necessary. No more than 30 gr. in 24 hours should be used, and two or three such intravenous injections usually suffice.

Sedation should be freely used and in such a way as to gain control of the patient's restlessness. In many instances this can be effected by the oral administration of nembutal or sodium amytal. When the patient is overactive or violent he should be given sodium amytal intravenously until the desired effect is obtained. This usually requires between 7 and 12 gr. It has been our practice at the onset of the illness, if the patient is having convulsions or is violent, to give sodium amytal intravenously; then while the patient is asleep to do a spinal puncture both for diagnostic procedure and for the relief of intracranial pressure. Following this the intravenous quinine dihydrochloride is given. Spinal puncture should be done in all cases at the outset and repeated daily until clinical improvement occurs. In most of our cases improvement was so rapid that only one spinal tap was done.

Absolute bed rest is an essential requirement. The patients must not be allowed to go to the head, nor even to sit up for meals until

they have had at least 1 week of normal temperature and freedom from symptoms. Two of our patients demonstrated the necessity for absolute bed rest by experiencing severe relapses with coma, convulsions, fever, and delirium. The first had just attained a normal temperature 4 days after the onset of coma and convulsions but was still having periods of irrationality and confusion and was showing signs of midbrain irritation by continuous hiccoughing. On attempting to transfer him from his cot to a litter he suddenly had a convulsion and lapsed into coma. Within 4 hours his temperature had risen to 105.8° F. For the next 48 hours his condition was grave. Coma was deep and he had involuntary passages of urine and feces. Continuous generalized and focal convulsions occurred and the hiccoughing continued. This condition gradually subsided following additional intravenous quinine therapy, however, and his temperature rapidly returned to normal. The other patient who had improved promptly after adequate therapy, became restless and disturbed during one night, fell out of bed three times and, with assistance, walked to the head once. Several hours later he began to have convulsions and had three such episodes within the next 4 hours without regaining consciousness. The next 2 days he was confused, disoriented, hallucinatory, restless, and at times violent. He responded promptly to additional intravenous quinine and sodium amytal therapy.

In one case the intravenous administration of quinine dihydrochloride was followed by a moderately severe shock reaction. At the conclusion of the injection the patient suddenly developed a dry hacking cough and complained of a sensation of heaviness in his chest. He became pale and restless and began to perspire. The pulse was regular but somewhat weak and rapid (108). The respiratory rate rose to 34 and the blood pressure fell to 86/50. One-half cc. of 1:1,000 epinephrine relieved the patient in about 15 minutes. While such alarming reactions do occur on infrequent occasions it is generally agreed that the risk of using quinine intravenously is outweighed by its lifesaving effect in cases of cerebral malaria.

K. MALARIA CONTROL PROGRAM ON A SOUTH PACIFIC BASE

FRED A. BUTLER¹

Lieutenant (MC) U. S. N.

The development of an effective malaria control program under wartime conditions on each of our malarious bases is highly desirable and often essential to the success of a military mission. It is not within the province of this paper to emphasize further the undoubted importance of military malaria control in tropical areas, but rather to present the program in effect on one base. Because of differences in vector, topography, climate, and strategy existing between localities, it cannot be assumed that the conditions existing on one base will be met on another, and many aspects of the following discussion are peculiar to this immediate area.

Malaria control on this base had its beginnings 1 year ago when occupying troops found themselves faced with an epidemic of malaria which threatened to become devastating. Preliminary surveys were hastily made, trained personnel was requested and secured, and a small control program was begun. As problems and needs became apparent the control group was gradually expanded. The present organization is felt to be efficient in that malaria is being controlled to an extent commensurate with military requirements, but as new lessons are learned and conditions change further revision of the organization and program will inevitably occur.

It is not surprising that a difficult malaria situation was early encountered. The base is located on a mountainous tropical island. The periphery of the island consists of a flat, poorly drained plain through which numerous small streams flow. This plain is covered in the main by either jungle or cocoanut groves. The island has a rainy and a dry season with a mean yearly rainfall of approximately 90 inches and a uniformly warm climate. It has been traditionally classified in the past as an unhealthy island. Its native and white population is almost invariably malarious, and census figures have declined for many years. No malaria control had been attempted prior to the arrival of United States forces.

The only vector of malaria present on the island is *Anopheles punctulatus* var. *moluccensis* Swell. (1921).² Pest mosquitoes, both

¹ Malaria control officer.

² Personal communication from Lieutenant, junior grade, K. L. Knight (HC) U. S. N. R.

aedes and culex, abound. This vector breeds freely in rain pools and other surface water accumulations such as road ruts and small puddles, and occasionally larvae are found in tin cans and other containers. During the rainy season the frequent flushing of streams following torrential rains apparently eliminates most of the stream breeding, but during the dry season *punctulatus* abound in semi-shaded marginal pools or areas of streams in which duckweed or other water vegetation partly covers the surface.

ORGANIZATION

The present malaria control organization operates under the direct charge of a malariologist and is one of a chain of like units existing throughout the South Pacific under a central command. Its officer strength is composed of 2 malariologists, 2 entomologists, and a civil engineer. Enlisted personnel attached to the organization consists of approximately 25 field and laboratory technicians. In addition, working parties are drawn from various units for work on projects of definite concern to these units; 1 man is detailed from each camp unit to assist in immediate camp malaria control and checking activities, and approximately 75 natives are available for manual labor on control projects. Officer and enlisted personnel are drawn from all United States services and Allied Forces. Because of difficulties arising from distance and other considerations it has been found necessary to divide the organization into 3 separate units widely dispersed. Work carried on in the 3 units is essentially similar, and supervising officers maintain close contacts with all units. Housing and adequate transport are available for efficient work, and control equipment and materials are at hand. That good malaria control is dependent upon an adequate source of supply is obvious, and it must be remembered that the scope and effectiveness of a control program is directly dependent on the amount and quality of personnel and matériel supplied.

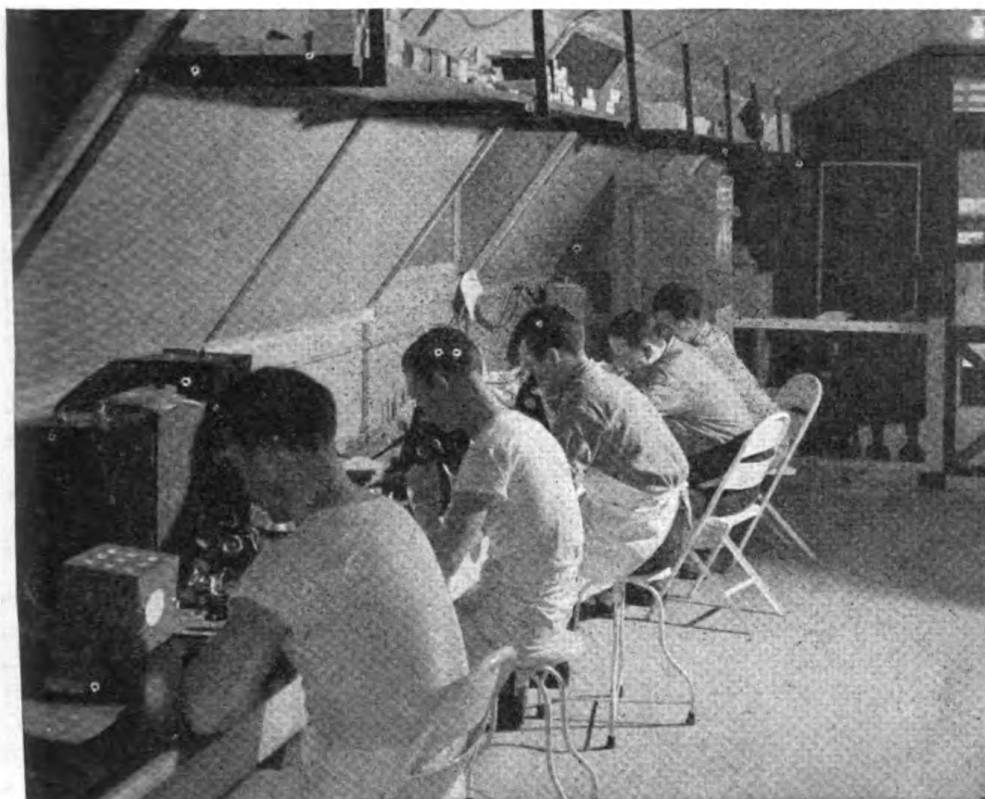
ACTIVITIES

Malaria control may be divided with some overlapping into six phases:

1. *Surveying and collecting of vital statistics.*—Any control program, no matter how elaborate, would be aimless without the direction supplied by an efficient surveying and checking squad. An estimate of long range effectiveness gained from the study of prevailing malaria rates is equally necessary. The nature, locality, and intensity of all control operations must be continually shifted and altered as changes in breeding areas, anopheline population, and malaria incidence dictate. Taken together and properly correlated these activ-

ities indicate the successes and failures of past control activities and the course to be followed in future operations.

Surveying and checking involve the use of two well-established procedures. These are dipping for anopheline larvae and the establishment of proper catching stations to measure the density of the anopheline population. Surveying is the constant search for new or uncontrolled breeding areas, and checking is the systematic examination and reexamination of areas under control to determine the efficiency of existing control measures. Larval dipping is carried out by a special group of field technicians of the malaria control organization on a definite schedule and results are carefully mapped and recorded. Numerous adult catching stations have been established



1. Malarial Control Laboratory, U. S. Naval Base Hospital ———.

and regular biweekly night catches of adult mosquitoes are made at permanent locations by men detailed from each camp unit and trained by malaria control personnel. These catches are classified in the laboratory by malaria control technicians and tabulated and mapped for locality and density. Standard New Jersey light traps have been also used to collect adult anophelines and appear to be efficient and satisfactory. The program of surveying and checking is supervised and results correlated by the entomologist in each area.

Collection of accurate malaria rates as well as intelligent thera-

peusis requires laboratory diagnosis of all cases of malaria.³ It was early found necessary to establish thick-film laboratories for malaria diagnosis, staffed by malaria control technicians, on various areas of the base due to lack of existing laboratories and trained personnel. Laboratory technicians from base medical activities have been trained where practicable in an effort further to increase the availability of diagnostic facilities. The diagnosis of malaria on the base during the past several months has been based on the demonstration of the parasite in the laboratory.

A system of reporting of malaria cases from all medical activities has been developed, and an alphabetical card index containing pertinent information on each malaria case occurring on the base is maintained. From this data accurate monthly malaria rates are made by area and unit, and for new admissions, readmissions, and total cases. These figures are carefully studied in conjunction with the findings of the checking and surveying squads, rainfall figures, troop movements, and other essential information, and from the conclusions reached malaria control month by month is shaped to attack most effectively malaria and the anopheline.

2. *Larval control.*—The control and eradication of anopheline mosquito larvae is approached by two fundamental routes. Every effort is made to drain areas suitable for breeding and maturing of larvae, and when and where breeding does occur an attempt is made to oil breeding areas promptly and regularly.

The base malaria control engineer is charged with the task of eliminating all possible surface water suitable for anopheline breeding, or converting it into channels unsuitable for breeding. The malaria control organization has no heavy ditching machinery, but such machinery is occasionally made available by engineer units. Native labor squads and working parties from adjacent troops are also used widely in work projects and are supervised by malaria control field men. Numerous drainage projects involving the digging of several miles of ditches, and the construction of culverts have been completed, and others are under construction. Construction of massive sump holes has been necessary in very flat areas to eliminate surface water. In other areas natural dry sink holes have been discovered, into which small streams have been directed. Two dams have been constructed and are utilized to impound water which is subsequently used to flush larvae from the stream margins below the dams. Stream courses have been altered to prevent natural pooling and overflow into flat areas, and stream clearance and channeling is a necessary and important adjunct of dry season stream control and has been practiced widely.

³ Much gratitude is due the staff of the hospital for its cooperation and material assistance in the establishment of efficient laboratory facilities and sound therapeutics of malaria over the entire base.

Of the group of procedures which have been employed, the ditching of low, poorly drained areas to eliminate surface water is considered the most important, and its continuation and extension is essential to any permanent malaria control which may be achieved on this base.

On the oiling squads falls the endless toil of systematically covering all surface water suitable for anopheline breeding with a film of oil. Automatic drip oilers have been employed on several streams with moderate success, and large and small power oilers towed or mounted on trucks have been used to oil suitable areas. However, the great bulk of breeding places has been and must be covered by the man on foot carrying a knapsack or garden variety sprayer. (Diesel No. 2 has been found most suitable for hand oiling.) Spraying squads, usually composed of ten natives or a 10-man troop working party supervised by one field technician are usually employed. They are followed as closely as possible by a light truck carrying oil for refilling hand sprayers. Smaller squads are used in oiling stream margins. Every effort is made to give each breeding area complete coverage weekly.

3. *Antimosquito measures*.—All antimosquito measures are based on the simple principle of avoiding as many anopheline mosquito bites as possible. A variety of measures are employed, and it is felt that good antimosquito measures can hold malaria rates to a safe level in the most malarious bases.

Proper selection of camp sites to avoid areas infected with a large anopheline population is the most valuable and practical method of avoiding anopheline bites. Quite often, however, strategical considerations may require a troop unit to be placed in a very malarious location. It is the duty of the malariologist to see that all troops in his area are placed in the most favorable location possible and that commanding officers are aware of the hazards likely to be encountered when an unhealthy area is entered. On this base a policy has been established whereby all proposed new camp sites are referred to the malaria control unit in each area for survey and recommendations, and the malaria menace in each area is then weighed against the reasons for occupying such an area. This degree of cooperation between operations officers and malaria control personnel has undoubtedly resulted in the prevention of many cases of malaria.

The maximum use of screening for tents, huts, or other living quarters is employed, and the only limitation to the program of screening has been the lack of screening material. There are available at present, however, adequate materials to screen all troop living quarters on the base as well as mess and recreation halls, and complete screening of all troops will be completed shortly. Bed nets are used routinely in all areas where mosquitoes are present in living quarters. Bed nets are regularly inspected and their proper use is required.

As *punctulatus* bites but rarely by day and habitually by night all night exposure is discouraged in malarious areas. Where night exposure during operations is necessary, the use of head nets, gloves, and full clothing is encouraged. In very malarious areas unauthorized persons found outside screens or nets after nightfall, or those found improperly clothed, are punished as offenders against military law.

As with screening, insecticides and repellents are used as they become available. Although the tremendous value of extensive spraying for adult mosquitoes is realized, lack of insecticidal sprays and dispensers has prevented development of an efficient spraying program. Repellents have been found to be particularly effective in preventing mosquito bites where extended night exposure is necessary.

4. *Carrier control*.—The existence of a civilian population well seeded with malaria on or near a base keeps alive the transmission of malaria as long as anophelines exist. In a military establishment under wartime conditions quick results are imperative, and all possible control measures are utilized to their fullest extent. The establishment of camp sites within one mile of native villages or quarters in malarious areas is prohibited. Troop camps are ordered out of bounds for civilians during the night hours and native villages are likewise out of bounds for troops. Segregation of this nature prevents a certain amount of transmission by infected anophelines, it is felt, but fails to prevent many cases of malaria, as is evidenced by malaria rates in anopheline infested areas where such regulations exist.

Thick-film blood surveys of numerous native groups on this base during the early months of its occupation revealed that from 10 percent to 49 percent of the native groups were blood-positive for malaria on one film, and the endemic index varied from 10 to 52. From 5 percent to 21 percent of all positive individuals also were positive for gametocytes. Surveys of large troop groups having a high malaria incidence, but who were receiving suppressive therapy, showed a mean positive group of less than 5 percent, with a virtual absence of gametocytes. Although the gametocyte index in most native groups has been low it is felt that the observations point clearly to their role as chronic malaria carriers and largely exonerates troop groups as sources of anopheline infection.

Although past experience would indicate that drug treatment of native groups as a means of eliminating malaria from an area is ineffective, it is felt that it offers a means of decreasing parasite density and diminishing the number of native carriers capable of infecting anophelines. The exigencies of military campaigns seldom permit opportunity for careful statistical studies, and it is difficult to evaluate exactly the results of this one phase of an interacting malaria control program. Drug treatment (1 week of atabrin, 0.3 gm.

daily) has been given to the great majority of natives and civilians on the island and from the tentative laboratory studies it promises to be of value. In one native village a survey of 124 individuals revealed a blood parasite rate of 16 percent with 2 films taken prior to mass therapy. One week of atabrin mass therapy was given and on completion, 2 blood films were again taken on the same individuals, and the parasite rate was found to be reduced to 0.83 percent. A similar study was made on 150 individuals in another village with a reduction in blood parasite positives to 1.3 percent from 12.3 percent. Surveys will be repeated at regular intervals, and mass therapy repeated when the number of blood positives shows a significant increase. Plasmochin was not considered safe for general administration in the absence of close medical supervision and was not employed. No ill effects were noted from atabrin administration.

5. *Drug control.*—The administration of antimalarial drugs in suppressive dosage to prevent the development of clinical malaria has been a widely-used procedure on this base. Atabrin has been used almost entirely, and in a dosage of 0.2 gm. twice weekly, or a total dose of 0.4 gm. weekly. It is recognized that in this dosage atabrin is merely effective in suppressing clinical symptoms of malaria in a certain percentage of infected individuals. It is believed that it does not prevent infection and that clinical malaria will develop in infected individuals after suppressive therapy is terminated. It was used extensively on this base during the early months of occupation when other control measures were ineffective. As malarious areas have come under control by field methods, suppressive atabrin therapy has been discontinued, and this policy will be continued. At present only groups occupying very malarious areas, or groups having had a heavy malaria experience and who are still quartered in moderately malarious areas are on suppressive therapy. Thus it is at present considered as a stopgap measure, and as other control measures become effective it is believed that it will be possible to discontinue all suppressive therapy.

No toxic effects of continued atabrin administration in the dosage of 0.4 gm. weekly have been observed. Mild initial intolerance consisting in the main of nausea, vomiting, and diarrhea are occasionally observed. Less than 1 percent of all men attempting to take suppressive atabrin have shown an absolute intolerance, usually manifested by repeated vomiting. A yellowish tinge to the skin is usually noted after several months' administration.

6. *Education.*—It is firmly believed that any military malaria control program will fail unless it has the intelligent and active support of the men and officers of the force for which it is intended. In order to elicit proper support it has been found that it is first necessary for officers and men alike to have a practical understanding of the epidem-

iology of malaria and its effect on the individual and the military mission. This education of the military public goes on almost continually and takes many forms. Much of the program is dependent on the cooperation and assistance of the unit medical officer. Through him is disseminated most of the medical information, direction, and advice that will reach troops, and every effort is made to keep him well informed and aware of his malaria problems. Bulletins and directives containing information and instruction are periodically prepared by malaria control personnel for issue by base commanders. Occasional announcements and short talks are made at movies regarding prevention of malaria. Camp areas are visited frequently and local control problems discussed with line officers as well as with medical officers. By all these means there is a constant striving to enlist the active participation in an appropriate manner of each officer and man in the base malaria control program.

Participation for the officer and man means first and pre-eminently the acquisition and constant practice of good malaria discipline. Good malaria discipline on this base implies a willingness and an ability to utilize individually and collectively all antimosquito measures available. Proper use of bed nets and screens should be unfailing, night exposure to mosquito bites should be habitually avoided, proper clothing should be worn after nightfall, and head nets and gloves when required should be worn faithfully. Insecticides and repellents should be used according to instructions. Atabrin when administered as suppressive treatment should be taken regularly and under direct supervision.

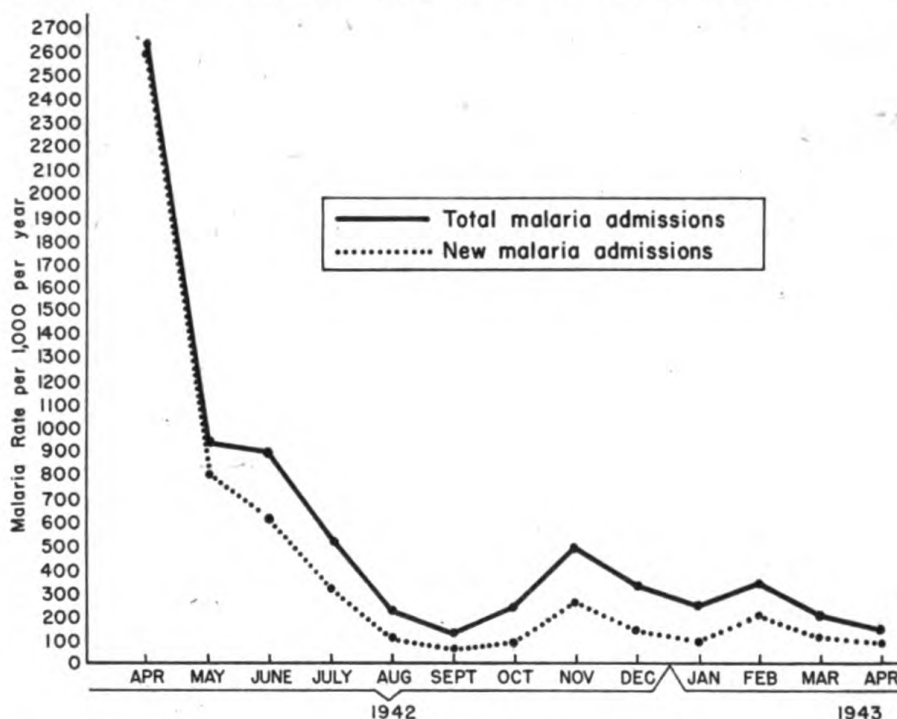
Officers must practice these measures conscientiously as an example to their troops and should instill habits of good malaria discipline into their men so that they become second nature. The quality of malaria discipline in troops is found to be invariably good or bad depending on the willingness of officers to assume responsibility in this matter. Good malaria discipline has held malaria to low levels of incidence in several units occupying very malarious areas, and its importance in malaria control cannot be overemphasized.

Individual units should carry out simple malaria control projects in or near their camps and be willing to supply working parties to the malaria control organization for control projects in their vicinity. Camp units have in general maintained good larval control in camp areas, and engineering units have given freely of their available time, equipment, and personnel in developing drainage projects.

RESULTS

The fundamental aim of the military malaria control program is to prevent the loss of as many man-days from malaria as possible. The only accurate yardstick by which the effectiveness of this program

can be measured is a study of malaria rates. In April 1942 there was a malaria rate among troops on this base of 2,645.3 cases per 1,000 per year for new admissions and 2,675.4 cases per 1,000 per year for all admissions (new malaria admissions and malaria readmissions). At this time there was no malaria control program in effect, the rainy season was still in progress, and drugs for suppressive therapy were inadequate. The malaria rate in April 1943 was 129.7 cases per 1,000 per year for new admissions and 178.7 cases per 1,000 per year for all admissions. The number of man-days lost in April 1943 was only one-fifteenth as great as the loss in April 1942 when



approximately one-fifth of the command developed malaria during the period of 1 month. This represents a tremendous increase in troop effectiveness.

Readmission rates for malaria have been high, as is shown in the graph. No determination of the relative proportions of relapses or recrudescences and reinfections has been attempted. Changes in species diagnosis on subsequent attacks have been sufficiently frequent to indicate that considerable reinfection does occur. Rates for new admissions give a far more accurate estimate of the effectiveness of the control program, but they are considerably conditioned by the great prolongation of normal incubation periods caused by the use of suppressive therapy. In November 1942 a sharp rise was noted in the incidence of new and recurrent cases of malaria. During the latter portion of October suppressive therapy was stopped on approximately

one-half the troops at that time on suppressive therapy, and the resultant rise in rates was noted in November. Late in November suppressive therapy was resumed, and rates again declined, illustrating the temporary changes induced in rates by changes in suppressive therapy.

Malaria rates were expected to increase greatly during the wet season, yet a general decline in rate has been noted during the rainy months of 1943. That the high rates prevailing in April 1942 did not recur is particularly gratifying.

The density of the adult anopheline population has steadily decreased during the 1943 rainy season, indicating the immediate effects of control measures during the wet season.

The establishment and maintenance of good control measures, and low malaria rates have contributed concretely to the sense of well-being among troops. It has allowed a more complete freedom for maneuvers, and has permitted the development of installations and roads without the constant hazards inherent in living and working in a very malarious area.

SUMMARY AND CONCLUSIONS

1. A malaria control program has been developed which is effective in controlling malaria among troops residing in an area where malaria has previously been rampant.

2. A variety of control methods have been employed including oiling, drainage, camp site selection, screening, carrier control, use of suppressive drug therapy, and establishment of good malaria discipline. It is important to stress that all nonessential detail has been eliminated from control methods. Many refinements of malaria control such as extensive preliminary surveys, collection of detailed data on the indigenous population, and dissection of anophelines, while valuable and important, have been largely omitted in the interest of developing an immediately effective program over the largest possible area.

3. The development of extensive drainage and stream clearance projects is considered the most important and effectual means of attacking malaria in this area.

4. Good malaria discipline is considered absolutely essential.

5. The use of insecticides and repellents has been minimal.

6. A highly malarious native population presents a constant source of infection for new anophelines. Atabrin mass therapy offers a means of reducing parasite density in carriers.

7. Suppressive therapy is considered to be an important temporary measure while an effective control program is being organized.

L. ENTERIC DISEASES ENCOUNTERED AT U. S. NAVAL BASE HOSPITAL ———

THOMAS V. GUDEX

Lieutenant Commander (MC) U. S. N. R.

FRANCIS O. FRY

Lieutenant (MC) U. S. N. R.

and

WILLIS H. TAYLOR

Lieutenant, junior grade (MC) U. S. N.

Fortunately, the dysentery problem in this area of the South Pacific has not been one of major proportions, either from the standpoint of severity of the diseases or from the viewpoint of epidemicity. However, the experiences of this hospital may prove to be of value to those encountering the dysentery problem in other tropical areas or to those who will encounter similar problems in this area in the future.

Shortly after arriving at this base, there was an outbreak of gastro-enteritis which reached epidemic proportions among the expeditionary force. Only a relatively small number of these persons were admitted to the hospital, these being the most severely ill. Practically all of the patients admitted had bloody stools and were acutely ill, with fever ranging from 101° to 103° F. This would indicate that, for the most part, these cases were probably of specific bacterial origin, and were instances of bacillary dysentery.

During the first several weeks there were no facilities for stool culture, and even microscopic study of the stools could not be done adequately. Until the permanent laboratory was placed in operation many of the early cases of gastro-enteritis were of necessity inadequately studied.

It is known that when a large group of men enter a tropical area for the first time they are quite prone to experience diarrhea or gastrointestinal difficulties, due for the most part to the metabolic changes induced by climate and living conditions in addition to the inevitable variations in food habits, with the addition of tropical fruits such as oranges, lemons, limes, tangerines, papayas, and cocoanuts.

Cases of simple diarrhea of 2 or 3 days' duration, often occurring two or three times a month in the same individual, were at first exceedingly common. Some were probably metabolic in origin, as a part of the physiologic adjustment to existence in the tropics, but most were undoubtedly due to the contamination of food by flies.

PREVENTIVE SANITARY MEASURES

Flies presented a serious problem. They were present everywhere in great numbers and are capable of spreading various types of enteric diseases. To combat this problem all galleys, mess halls, and latrines were screened as soon as screening materials became available.

One of the first steps taken to overcome this hazard was the construction of a barge for hauling garbage to sea. All garbage from the hospital area is dumped at sea daily. Combustible refuse and tin cans are hauled to a dump provided for that purpose, the tin cans are flattened, and all such refuse is burned daily after being sprayed with oil. The residue is then covered with dirt.

When first organized on the island, messing facilities were of necessity rather primitive and were similar to those utilized in field operations. After use, messing gear was cleaned of all residual food and was then rinsed three times in water kept boiling hot in tubs over open fires. The first rinsing was done in boiling soapy water while the remaining two rinses were in clear water. The gear was then dried or left to drain according to the discretion of the owner of the gear. Such methods were inadequate and often were not thoroughly carried out, despite supervision.

Upon establishment of the permanent base, the scullery was set up and operated much as at any large naval shore activity. Metal food trays are cleaned of all residual food and are then given to the scullery crew which passes the gear through an automatic spray washer and then into a large tank-tub of continuously flowing boiling water in which the gear is left for 2 minutes before being stacked to drain, on racks which permit proper drainage. The stacks are covered with netting and when set out for use at the next meal are nested face down in piles to prevent contamination.

Even such a method is not infallible in an area where the fly population is so heavy. During a minor epidemic of bacillary dysentery among the hospital corpsmen one of many spoons which were selected at random and cultured yielded a heavy growth of a member of the *Shigella* group of organisms. This was undoubtedly due to a break in the technic of cleansing since repeated cultures made following supervised cleaning of messing gear have revealed no pathogenic organisms.

Close attention has been paid to head and latrine facilities since arrival on the island. Originally the heads were of the closed-pit type, treated regularly with chlorinated lime. These were all screened as well as possible at the time and were made flytight. On establishment of the new base hospital only a few pit-type latrines were necessary, the heads installed in the huts being of the chemical tank type.

Sewage is pumped every 5 to 7 days from the chemical heads into a large disposal tank truck which conveys the sewage to the point of emptying in a large lagoon communicating with the open sea. Waste water from showers, galley, and laundry is carried by pipes and wooden flumes, and empties into a small gulley which has natural drainage away from the compound.

Throughout the hospital's existence on the island, the water supply has been provided from local streams through mains and is treated by filtration, chlorination, and coagulation. Regularly repeated examinations of the water in the tanks and mains has failed to reveal contamination at any time. However, it should be remembered that while the importance of water as a source of infection with bacillary dysentery is not as important as it used to be considered, its potential importance as a means for the spread of amebic dysentery cannot be overemphasized.

BACILLARY DYSENTERY

Patients admitted to the hospital with dysentery are routinely assigned to one of the three dysentery isolation wards. These wards are double-screened, have screened vestibule doors, and are located in a far corner of the compound, well away from the galleys and the other hospital wards. Extra precautions such as spraying, and killing all flies with swatters, are observed.

On admission, the patients are instructed individually in personal hygiene and strict personal cleanliness is enforced. All meals are served on the wards with food brought from the main galley. The utensils and messing gear remain on the ward, and are washed in boiling water and soaked in 2 percent cresylene solution for 15 minutes before being placed under cover until used again.

Soiled linen is also soaked in 2 percent cresylene solution for 6 to 8 hours before being wrung out and sent to the laundry. This strength of cresylene will kill intestinal pathogens in 30 seconds in vitro, the prolonged exposure being employed to insure that all parts of the linen are properly exposed to the germicidal solution.

Ambulatory patients are allowed out of the isolation area only to go to the movies. They may not visit on other wards, have visitors or go to the ship's service store. Recreational facilities are provided in the wards in the isolation area.

The heads are of the closed chemical tank type and are placed in a specially screened portion of the wards. For those patients who are acutely ill, a portable head is provided which may be used at the bedside in semiprivacy.

On admission, the routine laboratory work consists of a complete blood count, urinalysis, gross stool examination, and microscopic

examination for ova and parasites. The same stool specimen is also cultured. Because of the necessary lapse of time until the stool culture is completed and reported upon, if the microscopic examination shows the absence of ova and parasites and the stool has the gross appearance of one due to *Shigella* infection, appropriate treatment is instituted immediately. The drug of choice for the treatment of bacillary dysentery at this hospital is sulfaguanidine. The efficacy of the other sulfonamides in the treatment of this disease has been studied and is appreciated, but the results of therapy with this drug have been so uniformly excellent that no other drug has been employed to any extent.

The patient with bacillary dysentery who is admitted in an acutely ill state, with frequent watery and bloody stools and with acute abdominal cramping, is given 3 gm. of sulfaguanidine immediately. He is then given 3 gm. 1 hour later, followed by 3 gm. every 4 hours day and night. With this program the patient usually obtains relief from the frequency of bowel motions and cramping within 24 hours. Within 36 to 48 hours the stools assume an almost normal gross appearance and signs of cramping have ceased. After the bowel motions have subsided in frequency, the drug is given only four times a day in the same 3-gm. dosage. The drug is then continued at this dosage until the stools have been of normal frequency and consistency for 4 or 5 days. Administration of the drug is then discontinued and the patient is allowed to rest as a test of therapeutic efficiency for 48 hours and to permit the partial elimination of the drug from the intestinal tract. Stool cultures are then obtained every third day until three negative stools have been obtained. The patient is then discharged to duty as well.

During the past year, 53 patients with culturally proved bacillary dysentery have been admitted and treated. All were treated with the program described previously and excellent results were obtained in all cases. In only two of the cases was there a relapse, as shown by the finding of a positive stool culture after the drug had been discontinued. Both of these patients responded satisfactorily to a second course of the drug. In only one case was there any manifestation of a toxic reaction to the sulfaguanidine. This was evidenced by the appearance of a coarse, red, maculopapular rash over the abdomen, which rapidly faded on the discontinuance of the drug.

An interesting finding in nine of these cases was the appearance of organisms of the *Salmonella* genus, species undetermined, on the second and third stool examination after the discontinuance of the drug. In the absence of any clinical symptoms, this organism was adjudged nonpathogenic and the patients were discharged to duty. It is thought by some observers that the appearance of members of this group of enteric bacteria is explained by the fact that after the par-

tial sterilization of the intestine by a course of sulfaguanidine, this species is the first to regenerate to the point of appearing in cultures.

Of the cases of bacillary dysentery seen at this hospital, the duration of symptoms before admission has been from several hours to 5 days, the average being 2 days. The disease has been uniformly acute in its onset and severe in its symptoms, but diarrhea in a few cases has not been a dominant feature. The presence of blood in the stool has not been a pre-admission complaint in the minority of cases, probably because the type of head used in the field does not afford opportunity to view the stool after its passage. Fever, nausea, generalized aching and cramps have been the usual initial complaints.

Due to the exigencies of the military situation and the lack of certain materials, the pursuance of the diagnosis of the strains of bacteria to the final species was not possible until recently. All proved cases of bacillary dysentery have been reported as due to the *Shigella* genus of organisms. The cause of one of our minor outbreaks among the hospital corpsmen was traced to *Shigella ambigua* (Schmitz or *para-Shiga bacillus*). Thus far we have been fortunate in having encountered no cases of dysentery due to *Shigella dysenteriae* (*Shiga's bacillus*).

The average number of days on the sick list with this disease has been 24.1. This is an enormous gain over the amount of time lost in World War I when the average loss of time from duty was 141 days.

AMEBIC DYSENTERY

Only 9 cases of symptomatic amebic dysentery were seen at this hospital during the first year of its existence, although the cysts of *Entamoeba histolytica* were incidental findings in the stools of 27 other patients. Diagnosis in these 9 cases was made by the finding of trophozoites on microscopic examination of the fresh, warm stool specimen. The symptoms in these cases varied from an acute disabling type of dysentery, with 15 to 20 soft stools per day, to the light or "walking type" of dysentery. The average duration of symptoms varied from 1 week to many months. Treatment in these cases varied with the individual case. The acutely ill patients were started on emetine hydrochloride gr. 1, intramuscularly, given daily for 10 days. On the fifth day of emetine treatment the patient was started on carbarsone, gm. 0.25, three times daily for 7 days. The patient was then allowed to rest for 7 days before 5 daily stool examinations were submitted to the laboratory. In the event that symptoms did not cease by the end of the course of treatment, the dosage of carbarsone was increased to gm. 0.5 three times daily for as many as 10 days and the patient was Using this form of treatment, the average hospital stay was 37.5 days.

then allowed to rest without therapy for 1 week before the next stool examinations were done. In the event of the reappearance of symptoms during the week of rest, the patient was again given carbarsone.

The only harmful effect observed from the use of emetine in these cases was the occurrence of transient tachycardia in one case. The electrocardiogram in this case was negative, except for the sinus tachycardia. It has been our rule, however, not to give more than ten 1-gr. doses of this drug. Sigmoidoscopic examination was done on seven of the nine patients. Of these, five showed negative findings to the 10-inch level; one showed typical amebic ulceration at the 6-inch level and two showed atypical ulcerations. Direct smears made from the ulcers were positive in these three cases.

HOOKWORM DISEASE

This disease exists most often in this area concurrently with some other intestinal parasitic disease. Examination of the stools of 24 patients revealed the presence of hookworm ova but there were only 5 cases of uncomplicated hookworm disease. The disease was suspected if the eosinophil count was from 10 to 20 percent. Treatment in cases not complicated by the presence of *Ascaris* infection consisted of giving a light, fat-free meal, followed by a magnesium sulfate purge the night before specific therapy was to be given. Breakfast was omitted the following morning and 3 cc. of tetrachlorethylene in 1-cc. gelatin capsules were administered. This was followed 2 hours later by another dose of magnesium sulfate. The results in this form of therapy have been uniformly good. The patients suffered no ill effects from the drugs employed and the stools have been negative after one such course of treatment. The eosinophilia usually lasted until discharge of the patients, after which they could not be followed. If *Ascaris* infection coexists the preferred therapy consists of administering 1 gm. of hexylresorcinol crystoids (caprokol) orally on an empty stomach in the morning, being careful to have the patient avoid taking any food for 4 hours thereafter. By this means, about 50 percent of the hookworms and all of the *Ascaris* worms will be eliminated. Three days later the saline purge and tetrachlorethylene program described previously should be employed for the purpose of removing the remainder of the hookworms.

ACUTE GASTRO-ENTERITIS

Acute gastro-enteritis accounted for the majority of cases of enteric disease seen during the past year, there having been 190 such cases admitted to the hospital. The diagnosis was made on the basis of sudden onset of nausea, vomiting, and diarrhea with fever and malaise.

absence of bloody or leukocytic stools and the absence of *Shigella* organisms in stool cultures. These patients were treated symptomatically and the average length of hospitalization was 6 days.

The stool cultures of some of these cases were positive for a member of the *Salmonella* group of organisms, species undetermined. Two of the patients with *Salmonella* infections had unusually severe symptoms. One was treated with sulfaguanidine, gm. 2 every 4 hours for 4 days, while the second case was treated symptomatically. Both became asymptomatic after 7 to 10 days.

Differential diagnosis of the dysenteric disease is, in the last analysis, primarily a laboratory procedure, as the various etiological agents vary so greatly in their manifestations and in the intensity of symptoms as to mimic one another insofar as clinical symptoms and signs are concerned.



SULFAMERAZINE

Sulfamerazine was given to 200 unselected patients suffering with acute bacterial infections.

Toxic reactions possibly due to the drug appeared in 30 instances (15 percent), though in many of these instances it was not possible to determine whether they were due to the disease or to the drug itself.

Gross hematuria was observed in a single case receiving routine sulfamerazine treatment and 1 additional case receiving massive intravenous therapy.

No case of peripheral neuritis was seen, although 2 patients developed transient mental symptoms following sulfamerazine therapy.

On the basis of this short series, it appears that sulfamerazine is probably no more toxic than the sulfonamides now in common use and that further clinical trial is justified.—Clark, J. K.; Flippin, H. F.; and Murphy, F. D.: Studies on 2-sulfanilamido-4-methylpyrimidine (sulfamerazine, sulfamethyldiazine) in man; II. toxic manifestations. *Am. J. M. Sc.* 205: 846-851, June 1943.



DEVELOPMENT OF PENICILLIN RESISTANCE

Two strains of pneumococcus developed resistance to penicillin as a result of serial passage through mice treated with this drug. The rate at which resistance developed and the degree of resistance acquired varied significantly with the different strains. The resistance of the one strain tested was not impaired by 30 serial passages through normal mice, indicating that, once established, resistance to penicillin is retained for a considerable period. The development of resistance to penicillin in vivo was accompanied by an increase in resistance to this drug in vitro. The response of the pneumococci to sulfonamides was not altered by the development of resistance to penicillin.—Schmidt, L. H., and Sesler, C. L.: Development of resistance to penicillin by pneumococci. *Proc. Soc. Exper. Biol. & Med.* 52: 353-357, April 1943.

M. ACUTE INFECTIVE JAUNDICE AT U. S. NAVAL BASE HOSPITAL ———

WALTER M. SIMPSON
Captain (MC) U. S. N. R.

WILLIAM L. POWERS
Lieutenant Commander (MC) U. S. N. R.
and

ROBERT G. LEHMAN
Lieutenant (MC) U. S. N.

Jaundice of obscure origin has been of frequent occurrence in the South Pacific area. During a 1-year period, 320 patients with infective jaundice were admitted to this hospital.

The outstanding characteristics of this disease are similar to those usually associated with acute catarrhal jaundice. Clinically, all evidence points to an infectious hepatitis accompanied by a regurgitation, hepatocellular type of icterus. This disease bears every resemblance to what the English have called the "jaundice of campaigns" or what the French have referred to as the "jaundice of camps". Epidemic jaundice has occurred frequently among the troops of the United Nations in the Middle East during the present war. Jaundice of undetermined cause has been reported recently from the Anglo-Egyptian Sudan; yellow fever and leptospirosis were eliminated as causative factors in these cases.

ANALYSIS OF ADMISSIONS BY MONTHS

Only 15 patients with infectious jaundice were admitted prior to December 1, 1942; 1 in each of the months of August and September; 5 in October; and 8 in November. The disease began to reveal an epidemic character in December when 22 patients entered the hospital for acute infective jaundice. Of these, 20 were Marine Corps personnel from Base ———; 17 of the 20 were from the same infantry regiment and 12 of these 17 were from the same battalion. In January 1943, 60 patients entered the hospital for this disease. Almost all of these came from Army infantry regiments stationed at Base ———. Many noted the onset of symptoms at the same time and several became jaundiced on the same day. In February 1943, only 13 patients were admitted, but in March admissions for this disease increased to 80. Half of these came from a marine aircraft group. The remainder of the patients admitted in March represented sporadic cases of infective jaundice from Base ———. During April 1943, there were

130 patients admitted for jaundice. Again, almost one-half came from the aforementioned aircraft group. About 10 percent of the patients came from an aircraft group at another base. About 30 percent were sporadic cases of jaundice from an Army division at the same station.

CLINICAL FEATURES

In most instances the onset of the disease was marked by the sudden occurrence of chilly sensations and occasionally by a frank chill, followed soon by low grade fever, malaise, weakness, and headache. Anorexia and abdominal discomfort became noted shortly after the initial symptoms, and in some cases epigastric pain, nausea and vomiting occurred. The urine became dark in color about 4 or 5 days after onset and patent icterus of scleras and skin occurred 2 or 3 days later. Jaundice lasted from 2 to 4 weeks in the average case. Frequently the liver was enlarged and tender during the early phase of the disease. After the appearance of icterus the temperature remained normal in most instances. Bradycardia was observed commonly. The icterus indices in three-fourths of the cases ranged from 30 to 100 units. The erythrocyte and leukocyte counts were usually within normal limits and the relative percentage of lymphocytes was increased. There was no fatality among these patients at this hospital. About 6 to 8 weeks sufficed for complete recovery and there was no clinical or laboratory evidence that liver damage was to be permanent.

ETIOLOGY

The etiology of this disease remains obscure. There is no evidence of any relationship to malaria. There is no reason to believe that leptospirosis is implicated in the causation of this form of acute infective jaundice. Likewise, there is no evidence that jaundice was due in any instance to any toxic effects of atabrin which has been used so extensively at this base in suppressive and therapeutic doses. Furthermore, there is no evidence that acute infective jaundice in the South Pacific area is related to inoculation against yellow fever. The 28,000 cases of postvaccinal hepatitis which occurred in Army personnel during the first six months of 1942, were traceable in every instance to inoculation with specific lots of vaccine. Jaundice of such origin reached its peak incidence in the week ending June 20, 1942, and no new cases have been reported for several months. This type of jaundice followed after an incubation period of 40 to 120 days, depending upon lot numbers and conditions to which the individual was exposed. The disease was rare among naval and Marine Corps personnel. In contrast to these facts, epidemic jaundice in the South Pacific area

reached its peak in the first 6 months of 1943; practically all patients had been vaccinated against yellow fever from 12 to 24 months previously; the greatest number of patients were marines. Whereas about 60 patients died as a result of postvaccinal hepatitis, no patient died at this hospital as a result of acute infective jaundice. Finally, "armies in other wars and in other lands have had epidemics of jaundice in situations where no question of inoculations could arise."

TREATMENT

The therapeutic regimen employed at this hospital consisted of a diet high in carbohydrate and protein and low in fat, reinforced when indicated by the parenteral administration of dextrose and plasma and supplemented by the liberal use of polyvitamin tablets. Complete bed rest proved essential until hyperbilirubinemia was absent, and patients were not given ambulatory privileges unless the icterus index was less than 20 units.

ILLUSTRATIVE CASE REPORTS

Case 1.—The patient, a 22-year-old white marine, was admitted April 27, 1943, for jaundice. The present illness began April 22, 1943, with headache, anorexia, chilly sensations, and fever. Dark colored urine was passed on April 25 and pain in the upper half of the right side of the abdomen was noted a day later. Scleral and dermal icterus were noted on April 26. He had not had malaria. Examination was unremarkable save for icterus and hepatomegalia. The icterus index was 47. The hemogram was normal. Blood examination was negative for malarial plasmodia. The urine analysis revealed a trace of albumin, a few hyaline casts and the presence of bile. Uneventful recovery followed the therapeutic regimen outlined.

Comment: This is a fairly typical history.

Case 2.—The patient, a 23-year-old white youth from an Army infantry regiment stationed at Base ———, was admitted in April 1943, for jaundice and pain in the upper quadrant on the right side of the abdomen. For 5 weeks preceding admission he had been hospitalized at that base. At the onset of his illness he had had anorexia, nausea, and vomiting, accompanied by epigastric pain and choluria. Scleral and dermal jaundice soon followed. During the first week of hospitalization at Base ——— he had experienced chills and fever and blood examination had revealed malarial plasmodia. He received quinine and atabrin and made an uneventful recovery. After 3 weeks' hospitalization he was distinctly less icteric, but 1 week later (i. e., 1 week prior to admission to United States Naval Base Hospital ———) he again became jaundiced and icterus had become progressively deeper in the 5 days preceding admission. Physical examination was unremarkable save for deep jaundice and hepatomegalia and moderate weight loss. The icterus index was 115. After 1 week's treatment the icterus index was 118. The patient was transferred to an evacuation ship.

Comment: In this case the concurrent infection with malaria probably reactivated a hepatitis which was beginning to resolve.

SUMMARY

1. Acute infectious jaundice reached epidemic proportions among troops in the South Pacific area in December 1942, and during the first 3 months of 1943.
2. The disease occurred sporadically as well as epidemically.
3. The disease was benign and there was no indication that liver damage would be permanent.
4. The etiology of infective jaundice remains unknown. There is no demonstrable relationship to malaria, yellow fever vaccination, leptospirosis, or drug intoxication due to atabrin.



DETOXICATION BY LIVER EXTRACTS

In standardized and well-controlled experiments extracts of whole liver reduced toxic action of sulfanilamide injected intraperitoneally in toxic quantities (400 mg. per kilogram). The liver extract had the same effect on the toxic action of diethylstilbestrol in rats. In mice injected with a strain of *Streptococcus hemolyticus* the survival rate was higher when the sulfonamide was combined with liver extract than when the drug alone was given; in other words, the liver extract diminished the toxicity of sulfanilamide without impairing its bacteriostatic action. Whole liver or liver extracts counteract chronic intoxication by sulfonamide drugs. Whole liver extract apparently reduces the toxicity of two substances widely different in chemical structure and pharmacologic action. Both the evidence and the mechanisms by which these effects are secured invite further study.—Current comment: Detoxication by liver extracts. J. A. M. A. 122: 812, July 17, 1943.



ACUTE SUBDELTOID BURSITIS

A single treatment with a dose of 300 roentgens is usually sufficient although this may be repeated in from 7 to 10 days if there has been definite but incomplete relief.

The typical response in an acute case is a frequent but not inevitable aggravation of symptoms for 8 to 24 hours. It is well, therefore, to provide adequate analgesics and place the arm in a sling during this period. This short period of aggravation is followed by rapid relief of pain and limitation of motion, so that in most instances the patient is able to resume his normal activities in from 24 to 48 hours after treatment. Residual tenderness usually disappears in a few days, and the calcium deposits will be absent in many instances if roentgenograms are repeated in a few weeks. The results are often quite startling both to the patient and to the referring physician.—Brewer, A. A., and Zink, O. C.: Radiation therapy of acute subdeltoid bursitis. J. A. M. A. 122: 800-801, July 17, 1943.

N. PRIMARY ATYPICAL PNEUMONIA

EXPERIENCE AT U. S. NAVAL
BASE HOSPITAL ———

WILLIAM H. LEAKE

Commander (MC) U. S. N. R.

and

FRANK W. BLATCHFORD, JR.

Lieutenant (MC) U. S. N. R.

In the past few years attention has been increasingly focused on the pulmonary disease known by such names as acute pneumonitis, virus pneumonia, atypical pneumonia, acute interstitial pneumonitis and other terms. In accordance with a recent communication from the Surgeon General of the Navy these cases are classified as pneumonia, primary, atypical, etiology unknown.

This report comprises a review of 42 confirmed cases which have been admitted to the medical wards of this hospital in the South Pacific area during a 1-year period. As this disease is most commonly found in adolescents and young adults, and as the conditions of crowding and exposure necessitated by military life might be expected to increase the incidence of any communicable disease, it might have been anticipated that it would have occurred with some frequency. Such, however, has not been the case. This disease has comprised only 1.1 percent of the cases admitted to the medical wards. The incidence of respiratory disease in general, severe enough to necessitate hospitalization, has been strikingly low. This may in part be due to the climate of the tropics and the absence of abrupt changes in weather conditions. It may also be partly explained by the widespread use of the sulfonamide drugs early in the course of mild upper respiratory infections. That chemotherapy when given at the first sign of a "cold" will necessarily abort the disease and prevent the development of pneumonia cannot, however, be assumed. Two of our cases of primary atypical pneumonia occurred in medical officers who had been treating themselves with sulfonamides for some time before pneumonia developed. In speculating about the explanation of the low incidence of respiratory disease in this area, it is interesting to note that among the native population such is not the case. In several groups of natives who have come here from nearby islands, the incidence of pneumonia and the mortality therefrom has been high.

In our group of cases the diagnosis has in each case been confirmed

by x-ray examinations, and it has been based on a consideration of the clinical findings and course in conjunction with the roentgenographic observations.

CLINICAL DATA

Onset.—The onset in the great majority of cases was gradual. Cough was by far the most frequent distressing symptom. It was at first usually dry and hacking, later becoming productive of a rather scanty mucopurulent sputum. In about one-half of the cases the cough was preceded by pharyngitis, coryza, headache, generalized aching, and malaise.

Fever.—Almost all of our patients had felt feverish for a day or more before admission to the hospital. Although chilliness was not uncommon, severe chills were rare. On admission most patients had a temperature ranging from 101° to 102° F.; elevations above 103° F. were very rare. A rather striking fact is that in approximately 25 percent of our patients the temperature did not rise above 99.6° F. while in the hospital. Most of these patients had passed the more acute stage of their illness before being admitted. In two patients, however, admitted shortly after the onset of symptoms, the disease ran its full course without any temperature elevation over 99.6° F. In both of these patients the physical findings were limited to a few moist râles heard over the involved area. The roentgenographic examination in one showed many small scattered areas of infiltration in the lower half of the left lung field, and in the other a faint area of infiltration about 5 cm. in diameter in the left base.

Fever persisted in the majority of our cases for only 4 or 5 days. In only occasional instances did the temperature remain significantly elevated for more than 1 week.

Physical findings.—The most outstanding clinical manifestation of this disease in our group of cases, as well as in those reported by others, has been the scarcity of physical findings in the chest. The only more or less constant finding was that of fine or coarse moist râles. In most of our cases râles were noted at the time of the original physical examination. But the absence of all abnormal physical findings in the chest until the third or fourth day of hospitalization was by no means uncommon. Slight alteration in the breath sounds and some impairment of resonance were noted in a few cases; but frank signs of consolidation were notably absent.

Laboratory findings.—The conditions under which this hospital was functioning during the first few months of its organization, precluded any attempt at elaborate bacteriologic studies. Bacteriologic examination of the sputum failed to reveal any organism in great enough preponderance to be considered an etiologic agent. In no instance were pneumococci found.

It has been repeatedly pointed out that a striking characteristic of this disease from the laboratory standpoint is the absence of leukocytosis. In almost all of our cases the leukocyte count was between 6,000 and 9,000. Counts of over 10,000 were rare; but a leukopenia with counts under 5,000 was equally unusual. The differential count in most of our cases revealed a moderate increase in the polymorphonuclear leukocytes with a slight shift to the left. In a few cases there was a relative lymphocytosis.

Roentgenographic findings.—In three-fourths of the cases the pathology was to be found in the lower lobes of the lung. In a majority of cases the process was limited to a localized area of infiltration involving only a part of one lobe. In about 25 percent of the cases there were multiple small areas of patchy infiltration. In approximately 15 percent of cases the findings were merely those of a diffuse increase in lung markings at one base. In most instances the diagnosis of this disease, though strongly suspected, could not have been definitely established without roentgenographic confirmation; in a few cases it would not have been seriously considered. This is due to the fact that in the vast majority of the patients the physical findings were those of bronchitis rather than pneumonia.

Course.—In almost all cases the clinical course was exceptionally mild. Practically without exception, these patients were not at any time considered critically ill. Cyanosis and dyspnea were rare and in no instance was it considered necessary to administer oxygen. Signs of peripheral circulatory failure were not seen. There were no deaths. The average number of sick days was 20.

Treatment.—In addition to symptomatic treatment, sulfadiazine or sulfathiazole therapy was usually employed. The course of the disease was usually so mild that it is difficult to estimate the part which chemotherapy may have played. In general, it is apparent that chemotherapy does not seem to effect the sudden dramatic improvement which characterizes its use in the pneumococcic pneumonias.

SUMMARY

The incidence of primary atypical pneumonia in this tropical area has been low. It has not constituted an important problem from the standpoint of morbidity in personnel and there have been no deaths. With the exception that the disease has pursued a comparatively mild course, the disease as encountered here has not differed from that which has been reported from other parts of the world.

D. A STUDY OF PSYCHIATRIC CASUALTIES RECEIVED AT U. S. NAVAL BASE HOSPITAL — FROM THE SOLOMON ISLANDS BATTLE AREA

JAMES L. SAGEBIEL

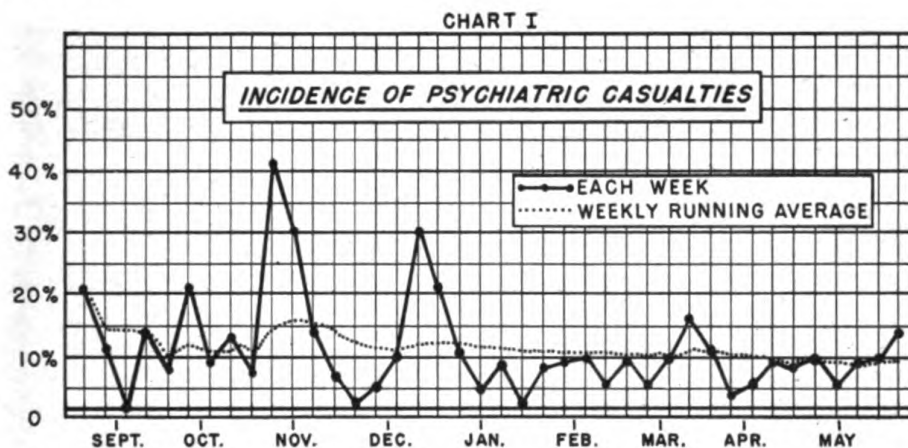
Lieutenant Commander (MC) U. S. N. R.

and

LEE C. BIRD

Lieutenant Commander (MC) U. S. N. R.

This report is based upon an analysis of 486 psychiatric casualties received from the Solomon Islands battle area during a period of 9 months. In addition, 120 psychiatric cases have been received from the personnel on this island, none of whom have been exposed to direct combat conditions. Of these 17 were psychoses. The remainder constituted predominantly psychoneuroses with a sprinkling of epileptics, psychopaths, and feeble-minded individuals. This makes a grand total of 606 cases admitted to the Neuropsychiatric Service of United States Naval Base Hospital — during its first year of operation.



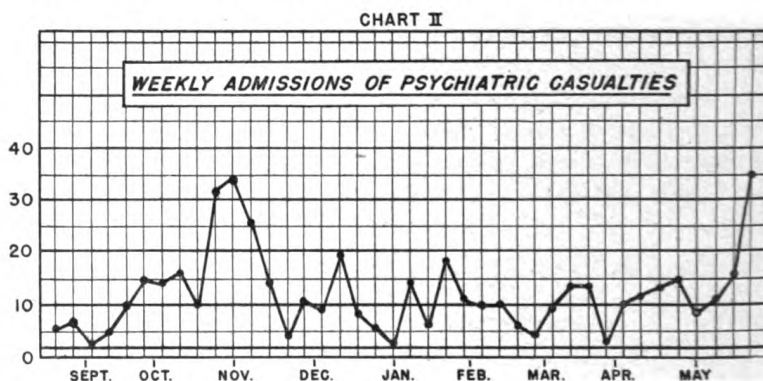
This report is limited to a discussion of the study, treatment, and disposition of apparently well-adjusted individuals who developed nervous or mental conditions under the stress of actual battle action or in nearby danger zones. It is of particular significance because it was the psychiatrist's first opportunity to analyze the mental, emotional, and behavioristic reactions of a group of American troops under the combat conditions of their first offensive campaign in the South Pacific area.

Chart I illustrates the incidence of psychiatric casualties in comparison to the total number of casualties received. It is calculated on

a weekly basis. The dotted line represents the weekly running averages which show the general trend to be toward the 10 percent line. Roughly, the admission of psychiatric casualties varied directly with the intensity of combat activity.

Chart II represents a graph of the actual number of psychiatric cases received weekly. In general, the left half of the chart, that is, up to about the middle of December 1942, pertains only to marines. The right half of the chart pertains essentially to Army personnel. Nearly 90 percent of the psychiatric casualties among Navy personnel occurred after the middle of January 1943.

Of the total of 486 psychiatric casualties received at this hospital from the Solomon Islands battle area, 42.1 percent were from the Marine Corps, 32.6 percent from the Army, 20.5 percent from the



Navy and 4.8 percent from the Air Forces of all three branches of the service.

CAUSES OF BREAK-DOWN

The etiologic factors involved fall into two main categories, fundamental causes and precipitating causes. The former were those common to the neuroses and psychoses of civil life, while the latter were the local environmental factors which precipitated the development of a psychoneurosis or psychosis.

Under the fundamental causes must be listed primarily a fear of death. A corollary to this is fear of pain or of invalidism and feelings of inadequacy and insecurity. In noncommissioned and commissioned officers the increased responsibilities and feelings of solicitude for their men play a part. Feelings of guilt over killing appeared in only a few cases in this series.

The precipitating causes were principally fatigue, lack of sleep over long periods of time, disturbed sleep, inadequate food and drink, unusual enemy tactics, noise, and blast concussion.

In most cases a combination of these factors resulted in the ultimate

break-down but the precipitating causes can be grouped broadly according to the effects produced on the psyche, the physiologic and metabolic mechanisms and the personality as a whole.

Fatigue, lack of sleep or disturbed sleep, and inadequate nutrition may be grouped together because of their gradual, physically debilitating effect on the individual. In many of these cases it required a nearby explosion with or without concussion as the final precipitating agent in the break-down. In many cases, the story has been that for long periods of time they would work all day at digging fox holes, building bridges, or repairing the airport and other facilities and then have their sleep disturbed at night either through necessary watches or enemy action. During the first 6 weeks of action, rations were considerably shortened and many reported subsisting on captured barley and rice for 2 or 3 weeks at a time. Although extreme fatigue and exhaustion were rarely proposed as a chief complaint, it was evident in many cases. The weight loss averaged about 20 pounds per man. Examination revealed marked dehydration as shown by the dry skin and sunken eyes. Intra-ocular tension was generally reduced although tonometer readings were not made. Cases in which the factors of fatigue, loss of sleep, or disturbed sleep and inadequate nutrition were paramount, tended to develop psychosomatic exhaustion states with or without anxiety. These states would develop slowly and reach their disability level after about 4 to 6 weeks. In many of these cases the final precipitating event was a nearby explosion or some emotionally disturbing experience.

Enemy tactics and noises were frequent contributory precipitating factors in the causation of break-downs. Such enemy tactics as infiltration through the lines at night, excellent camouflage, sniping, treachery, and fanaticism intensified the fear of the unknown. Many patients who had no anxiety during the daytime, would develop a state of anxiety and nervous tension at night out of proportion to the situation. Noise in the form of rifle and machine-gun fire, mortar, and artillery fire, plane motors, bomb explosions, and shelling by surface craft, had its effect, great or small, on the individual, depending upon its intensity and prolongation and his own psychic associations to it. Stimuli of this nature would result for the most part in anxiety states associated with continuous nervous tension and hypersensitivity to noises.

Among the ship personnel nervous and mental break-downs were related to severe battle actions and in some cases to the necessary restraint and close confinement during many months of sea duty. The latter tended to bring out subclinical cases of emotional instability and other types of constitutional psychopathy.

The last precipitating cause, blast concussion, undoubtedly was not seen as frequently in the psychiatric department as it occurred, since

many of these patients were also wounded and remained on the surgical wards. Unless their confusional state resulted in abnormal behavior they would not be seen by the psychiatrist, and while remaining in bed during the healing of their wounds would recover as well from their mental state. Many of these patients reported being buried in fox-holes, blown out of trees, blown through the air or knocked out. When a blast concussion occurs which is severe enough to produce semiconsciousness or complete unconsciousness, one must accept the fact that there has been a sudden disturbance of physiologic equilibrium of the brain and that there has probably been some microscopic structural damage. None of the cases in this series came to autopsy. None presented any clinical neurologic signs suggesting intracranial damage.

In support of the theory that histologic changes do occur in the brain following concussion, de Gutierrez-Mahoney studied the brains of four human beings, 20 to 39 years of age, who died within 12 to 48 hours after cerebral concussion. He also studied a series of dog brains in which concussion was produced experimentally. Differential staining was used to study all the neural elements. He found small round structureless areas in the white matter composed of perivascular hemorrhages surrounded by demyelinated and fractured axis cylinders. In these areas were striking collections of fat globules around the blood vessels and even within the blood vessels. In the gray matter numerous ganglion cells showed varying degrees of degeneration extending into the axons.

Against this theory, and related to this series of cases, is the fact that the concussing agent is a blast rather than a direct blow with a hard object and that there is, therefore, some cushioning effect. Then, too, these patients tended to manifest a rapid return to normality indicating that the major part of the syndrome was due to a disturbance of physiologic equilibrium of the brain and that structural damage must have been minimal.

REACTION TYPES

As experience with these cases expanded, they were considered less and less to be psychoneuroses or psychoses but were regarded more as psychoneurotic or psychotic reactions. Only 17 miscellaneous patients whose symptoms existed prior to exposure to battle conditions or entrance into the danger zone and whose disability was not increased thereby, were not so classified. The remainder, except for a few epileptics, were specifically related to the precipitating causes discussed above.

The psychosomatic reactions of the personality to battle situations can be broadly grouped into 4 main classes: (1) The psychoneurotic or anxiety reaction types in which psychic and emotional symptoms were paramount; (2) the hysteric types in which various types of conver-

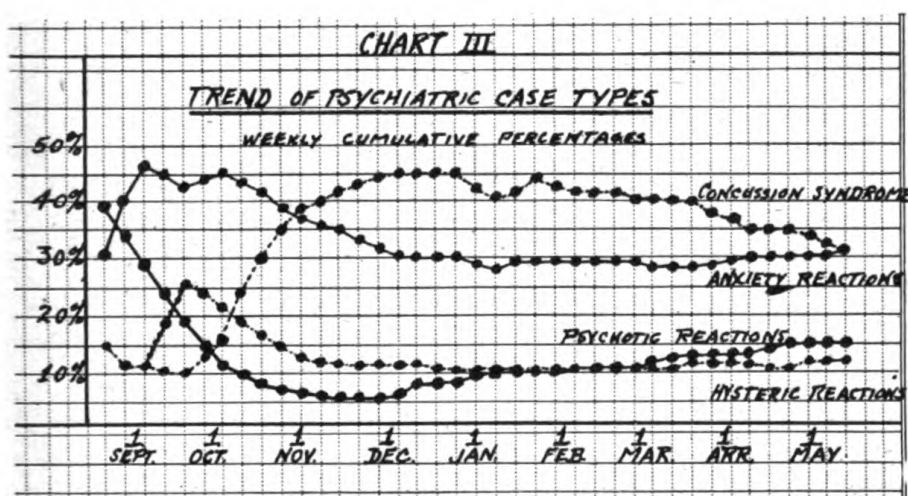
on phenomena and other escape mechanisms appeared as the dis-
ling factors; (3) the psychotic reaction types; and (4) the con-
ssion syndromes.

The incidence of occurrence of these various types is shown in
ble 1.

TABLE 1.—Incidence of types of cases

	Number	Percent		Number	Percent
Concussion syndrome.....	152	32	Miscellaneous types.....	31	6
Anxiety reactions.....	149	31	Unclassified (records not available).....	11	2
Hysterical reactions.....	58	12			
Psychotic reactions.....	75	15			
Epilepsy.....	10	2	Total.....	486	100

It has been instructive to observe the trends taken by the various
types of cases, and this is shown in chart III which illustrates the in-
cidence of each in comparison to the total number of psychiatric
cases.



Thus one can observe the upsurge of anxiety reactions which oc-
curred during the first 2 months when the marines were establishing
beach-heads and seizing the airfield. It was during this time that
enemy tactics, shortened rations, disturbed sleep and continual har-
assment had their effects. From then on the trend was downward
until the middle of March 1943, when it again became reversed. On
the other hand, concussion syndromes were not frequent until the
latter part of October and during all of November and December
1942, when heavy close fighting took place. From then on, except
for a rise in the middle of January 1943, when the push to eliminate
all enemy resistance occurred, the trend has been steadily downward.
The hysterical reactions had an initial rise but from then on the per-
centages rapidly reached the base line. The relative number of psy-

chotic reactions was high at first but within 3 months had fallen to its lowest incidence of 6 percent. From this point there was a gradual but steady rise to 15 percent.

The concussion syndrome, with 152 cases, comprised 32 percent of all cases and exhibited some unusual features. The syndrome differed somewhat from that seen in civilian practice. The history usually revealed that the individual had been rendered unconscious, semiconscious, or dazed by a nearby explosion. The dazed feeling would last a variable period of time and during this period he would likely have spotty amnesia and some mental confusion. Beginning a few hours after the explosion the patient would experience headache, tinnitus, tremors and shaking spells and increased sensitivity to unexpected noises, all of which would tend to clear up within 1 or 2 weeks. In emotionally unstable individuals one or more of these symptoms might persist and there would gradually develop superimposed anxiety, hysterical conversion phenomena, insomnia, and dizzy spells. The nausea, vomiting, and retrograde amnesia, common to civilian cases, were not seen. About 10 percent sustained rupture of the tympanic membranes. The number of concussion cases was directly related to the intensity of battle action.

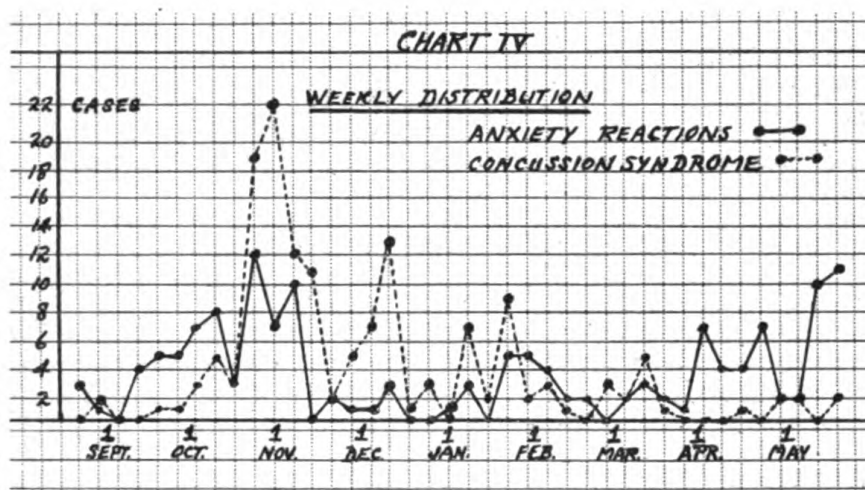
The psychoneurotic or anxiety reactions comprised 149 cases. They represented 31 percent of all casualties and were related mostly to fear of the unknown. They occurred predominantly during the first 2 months while becoming accustomed to unusual enemy tactics and learning methods of jungle warfare. Physical debility, due to illness, fatigue, loss of sleep, and constant harassment, played a prominent part in the development of this type of reaction.

The usual clinical syndrome associated with the anxiety reaction consisted of tremor, both somatic and splanchnic, emotional instability with hypersensitivity to unexpected noises, a feeling of being dazed and mentally confused, intense anxiety or feeling of apprehension, and insomnia in spite of much loss of sleep. Other symptoms which occurred with moderate frequency were hysterical spells, characterized by suddenly going to pieces and screaming, crying or running around, amnesia of varying intensity and duration, inability to concentrate, periods of depression, crying spells, fainting spells, anorexia in spite of inadequate food intake, and cardiac palpitations. Strangely enough, although all these patients appeared exhausted, haggard and worn, very few complained of fatigue. A secondary nutritional anemia occurred in a few cases. Repetitions of the blood counts showed that the red blood cell levels were restored to normal within 1 or 2 weeks.

These patients had a less favorable prognosis than those with the concussion syndrome and usually required evacuation to a distant base hospital. Many recovered symptomatically after 2 to 4 weeks but

when confronted with the idea of returning to duty would experience a recurrence of their symptoms. It was found that a good test of their emotional stability and fitness for duty was to announce they were being sent to duty several days hence and then observe the reaction. If the information was received with complacency and some degree of eagerness to return to their organizations a trial of duty was given. If any signs of emotional instability, anxiety, restlessness, insomnia or other symptoms appeared they would be evacuated.

Chart IV graphically contrasts the number of anxiety reactions and concussion cases and shows how they were distributed over a 9-month period.



There were 58 major hysterical reactions, an incidence of 12 per cent. Table 2 divides these into the various major subgroups:

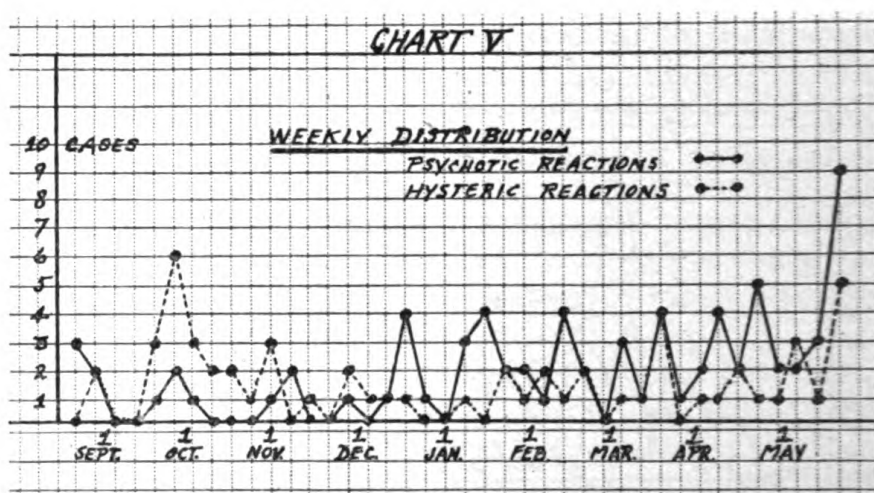
TABLE 2.—Types of hysterical reactions

	Number	Percent		Number	Percent
Paralyses.....	22	38	Systemic disorders (gastro-intestinal, cardio-respiratory or genito-urinary).....	11	19
Sensorimotor, 16.			Muscular tics and tremors.....	6	10
Special senses, 6.			Pains (headache, backache, etc.).....	4	7
Fugues.....	14	24	Camptocormia.....	1	2
Somnambulism, 7.					
Amnesia, 3.					
Coma and/or convulsions, 4.					
			Total.....	58	100

All represent escape mechanisms unconsciously produced. The majority were elaborated on the somatic level; they included the paralyses, the systemic disorders, the tics, which were continuous massive, gross, jerking movements involving almost all the muscle groups of the body, various pains, and one case of camptocormia. The fugues were elaborated on the psychic level and represented a complete rather than a partial flight from an unbearable situation.

Two cases of muscular tic involving the muscles of the face, neck, and upper extremities cleared up completely with metrazol therapy. The case of camptocormia failed to respond to psychotherapy but was entirely relieved with one metrazol convulsion.

Two-thirds of the hysterical cases disclosed some type of nervous disorder in their past histories. The various conversion phenomena were usually rapid in onset, and were related directly to danger or to a minor wound or accident in a dangerous situation. A small number of these cases responded to psychotherapy but their stability was precarious and they were evacuated.



One of the most interesting groups among the psychiatric casualties comprised those with psychotic reactions. Its chief importance lay in the serious prognostic implications of prolonged convalescence or the development of a permanent psychosis. These cases, in contrast to the other types, presented special problems. As in psychoses in civilians, they were irresponsible and had to be closely supervised. This required additional personnel. Roughly one-third were difficult to manage and required isolation or restraint of some kind. Many had periods of excitement and at times would become noisy, destructive, violent, combative, or dirty.

Seventy-five patients with psychotic reactions were admitted. They represented 15 percent of all psychiatric casualties. A past history of nervous or mental disease was present in 27 percent. Some had been in State Hospitals for the Insane and a few had had courses of shock therapy. They were roughly classified into cyclothymic and schizophrenic reaction types with the recognition that the acute confusional psychoses, reactive depressions, exhaustive psychoses, and other types due to the stress of battle situations, could be further subdivided.

The schizophrenic reaction types outnumbered the cyclothymic by about three to two as seen in the following table:

TABLE 3.—*Types of psychotic reactions*

	Number	Percent		Number	Percent
Cyclothymic reactions.....	29	39	Schizophrenic reactions.....	46	61
Manic, 23					
Depressed, 6			Total.....	75	100

All psychotic patients were evacuated eventually to base hospitals farther removed from the battle area. An attempt was made to retain them until the acute psychotic manifestations had quieted down but military expediency sometimes demanded evacuation after a stay of only a few days at this hospital. The average period of retention in this hospital for this type of case was 12 days. Thirty-three percent improved spontaneously with rest, isolation, sedation, and psychotherapy after an average of 7.4 days. Sixty percent did not improve and were evacuated.

Many had an acute onset precipitated by air raids or battle situations. Tribute should be paid to the air transport organization which transferred these cases from the field of battle in ambulance planes to this hospital and made it possible for the psychiatrist to see the patient shortly after the onset of the condition. Usually those patients whose disease had a sudden acute onset showed an equally rapid amelioration of symptoms after a few days' rest and quietness.

Those who had a slow and insidious onset not precipitated by actual combat conditions tended to show little or no improvement under conservative therapy.

PROGNOSIS

In considering the prognosis for these cases, one must approach the group as a whole from the military standpoint and consider the problem from both the short-term and the long-term point of view.

The short-term problem resolved itself into salvaging as many patients as possible both for return to combat duty and, in the greater number of cases, for assignment to noncombat duty. A relatively small percentage were considered completely unfit for duty and were evacuated for later medical survey.

The long-term problem involves rehabilitation in a noncombat zone but in a military atmosphere for the purpose of preventing postwar neurotic and psychotic invalids.

Very few of the psychiatric cases from this hospital were returned

directly to duty, the chief reason being that because of the military situation, it was impossible to keep the patients here long enough to insure adequate convalescence and a return of emotional and mental stability.

TREATMENT

Treatment has consisted essentially of rest. All were given phenobarbital, grain one-half, three times daily, or sodium amytal, gr. 3, or nembutal, gr. 1½, before retiring, when available. A few of the more severe cases of insomnia or those exhibiting pathological excitement were given sodium amytal intravenously with satisfactory results. In two cases of massive muscular jerking one such treatment eliminated the symptoms. All patients were placed on vitamins in adequate amounts.

Psychotherapy in the form of allowing the patient to talk about his experiences, although it at times produced temporary periods of excitement, resulted in definite gains. Assurance that the condition would clear up soon and that they would be evacuated for a rest period helped considerably. Suggestion, persuasion, and occupational therapy were all of benefit.

Convulsive shock therapy was used in only 11 cases because of an inconstant and inadequate supply of metrazol. Electric shock apparatus was not available. In the selected cases in which metrazol was used, however, the results were highly satisfactory.

The object in treating these cases with convulsive therapy was not to attempt a profound change in the individual's personality make-up, but to give only sufficient treatment to render him symptom-free, or if that appeared unlikely, to reduce the intensity of his symptoms so that he could be transferred to an open ward and later evacuated with a minimum of trouble.

Four psychoneurotics received convulsive therapy. Two of them were cases of massive muscular tic which failed to subside on conservative therapy. Each was relieved of the condition after a single treatment. Another patient, who had an anxiety reaction, improved so markedly after one treatment that he was returned to duty after an adequate period of observation. The fourth case was one of camptocormia; one convulsion resolved the conversion mechanism.

Treatment of psychotics with convulsive therapy was reserved for the worst cases. The results were striking. Seven cases were treated and all became sufficiently symptom-free to permit their transfer to an open ward. Unlike the psychoses encountered in civilian practice, these patients responded rapidly and, in some instances, dramatically to only 2 or 3 convulsions. The average number of treatments given to each patient was 5, although one patient with catatonic schizophrenia

was refractory and required 13. The average length of time required for marked improvement was 4.5 days and the average stay in the hospital for this group was 23 days. The value of any type of treatment of psychiatric casualties cannot be estimated, however, because of the inability to observe the patients over a long period of time. The final mental and emotional adjustments which each psychiatric casualty evolves are of the greatest importance to the individual and to the Government and may, with adequate treatment at advanced base hospitals, be directed along healthy lines.



ANTACIDS IN DUODENAL ULCER

The in situ effects of antacids on duodenal acidity in patients with duodenal ulcer cannot be predicted from their behavior in the stomach.

After the ingestion of an antacid by a patient with duodenal ulcer none of the customary indexes of gastric acidity may be taken to indicate reliably the coexistent effective acidity (pH) in the duodenal bulb.

Oral administration of an antacid in the usual therapeutic dose to a patient with duodenal ulcer does reduce the acidity of the contents of the first part of the duodenum. The reduction of intra-duodenal acidity, however, is neither great nor long lasting and may be followed by a rebound increase.

The beneficial clinical action of antacids in the management of patients with duodenal ulcer must be attributed to something more than their slight efficaciousness in reducing acidity at the site of the ulcer.—Berk, J. E.; Rehfuess, M. E.; and Thomas, J. E.: In situ effects of antacids in duodenal ulcer. *Arch. Int. Med.* 72: 46-57, July 1943.



PHENOBARBITAL AND ALCOHOL

Ethyl alcohol (alcohol U. S. P.) and drugs of the barbiturate group rank high among the agents that are commonly responsible for death by poisoning. In view of the frequency with which these substances are ingested it is surprising that there have been so few controlled observations of the extent to which they may exert a synergistic effect. Since each substance when ingested in a sufficiently high dose acts as a respiratory depressant, a combined dosage might reasonably be expected to have an additive effect.

In an active pathologic service concerned with the investigation of medico-legal deaths it is commonly observed that if both alcohol and a barbiturate have been ingested, death is likely to occur earlier in the course of the intoxication than it would ordinarily if either substance had been taken alone. Moreover, the observation has been made that when fatal poisoning has resulted from the joint action of ethyl alcohol and a barbiturate, neither agent alone was ingested in sufficient quantity to account for death.—Jetter, W. W., and McLean, R.; *Forensic medicine. Poisoning by the synergistic effect of phenobarbital and ethyl alcohol; an experimental study.* *Arch. Path.* 36: 112-122, July 1943.

P. A YEAR'S LABORATORY EXPERIENCE AT U. S. NAVAL BASE HOSPITAL ———

WITH A CASE REPORT OF A TRANSFUSION PHENOMENON

HENRY C. ALLEN
Lieutenant (MC) U. S. N. R.

The laboratory of United States Naval Base Hospital ——— went into commission on May 15, 1942, when a microscope was obtained from the storehouse and the director and a single laboratory technician began doing blood counts, urinalyses, and malarial smears in the laboratory of a small local civilian hospital. Later in the month a branch laboratory was established in one of the residences which had been acquired as a temporary hospital building. All the laboratory work was performed in these two temporary laboratories until September 22, 1942, when the laboratory of the permanent hospital was opened. Up to May 1, 1943, a total of 46,606 tests were performed.

The goal was to furnish the hospital with laboratory facilities equal to any naval hospital in the continental United States. It was felt that that was also the aim of the Bureau of Medicine and Surgery when it provided adequate equipment for this project. At times the work was hampered by lack of specific reagents; but by various means these were gradually accumulated until, at the year's end, there were only a few of the rarer types of procedures which the laboratory was unable to perform.

The most valuable item of equipment has been the microscopes. since 85 percent of the laboratory work during the year was done with the aid of that instrument. The microscopes were not adequate in number during the early part of the year but later were augmented by those obtained by the malarial control unit.

Since the establishment of the laboratory each patient entering the hospital has had a complete blood count, a complete urinalysis, and a smear for malarial parasites. In a great many instances these procedures have proved their value in hastening diagnoses, evaluating prognoses and determining whether a patient should be retained in the hospital until completely well or evacuated.

The type of laboratory work required in an advance base hospital of this kind will now be discussed in detail.

MALARIAL SMEARS

During the year hospital admissions for malaria were 24 percent of the total admissions to the hospital, so that the diagnosis of malaria was the largest single laboratory problem. During the year a total of 14,046 smears on hospital patients were examined for malarial parasites. This represented 30 percent of the laboratory work. Early in the work, diagnosis was made on thin smears due to the lack of experience in thick smear technic and the lack of Giemsa's stain. In July 1942 the malaria control unit was established at this base and routine thick smear diagnosis was inaugurated. When the permanent laboratory was established the diagnosis of malaria was taken over by the laboratory unit of the malaria control unit, and it has remained under their supervision. Without their aid the diagnosis of malaria would not have been as expeditious or as accurate as regards species diagnosis.

HEMATOLOGY

The field of hematology represented 26 percent of the total laboratory work. It was observed that many of the early casualties from Base ——— had anemia out of proportion to the extent of their wounds. There was often a red blood-cell count of 3 to 3.5 million. This degree of anemia corresponded to the period when fighting at Base ——— was very intense and the food supply was inadequate. Later, when conditions improved, the casualties did not show this degree of anemia unless there was extensive loss of blood or severe malaria.

There was one case of sickle-cell anemia which presented quite a diagnostic problem before developing the anemia, because of severe pains in the legs. The nature of the disease was not suspected until the sickling of the red blood cells was discovered while doing a routine differential count.

From indices calculated on the blood of patients with postmalarial anemia, it was noted that the anemia was often of the macrocytic hyperchromic type. The reticulocyte response in such cases was very great, sometimes reaching 10 percent. The type of antianemic therapy given these patients did not seem to influence their rate of recovery. Only one case of severe purpura was seen, and this cleared promptly after the administration of vitamin C.

In the 10,644 differential smears made in the laboratory during the year none presented the picture of leukemia and only a few resembled infectious mononucleosis. Many of the patients showed an eosinophilia which in some cases was quite marked. This was often unexplained. Some cases could be accounted for by intestinal parasites, particularly hookworm. Muscle biopsies for *Trichinella spiralis* were

performed in several instances without revealing the presence of this parasite. Antigen for skin testing for trichinosis was not available but none of the cases resembled acute trichinosis clinically.

The sedimentation rate (Cutler) was used extensively and was particularly valuable in differentiating organic from functional disease and in following the progress of patients with pneumonia and other infectious diseases.

Hematocrit determinations were done on many of the patients with burns, but most of these were out of shock by the time they reached this hospital, and the determinations provided only confirmatory evidence that most of the patients needed no more plasma.

URINALYSIS

Urinalyses formed the third largest group of tests, a total of 10,552 such tests being performed during the year, or 22 percent of the total number of tests. Every analysis included determinations of specific gravity, of reaction for sugar, for albumin, and of the character of formed elements of the centrifuged sediment. Many transient pathologic urine specimens were seen in cases of malaria and of war wounds, but there were only a few cases of severe nephritis. Many sulfonamide crystals of all types were seen in these urines but in only one instance were these crystals suspected of causing ureteral obstruction. Since many of the patients had jaundice, a determination of bile and urobilinogen in the urine aided in evaluating the liver damage in these cases.

BACTERIOLOGY AND PARASITOLOGY

Bacteriologic and parasitologic examinations comprised about 7 percent of the work and consisted mainly in the examination and culture of feces. From time to time there were mild epidemics of diarrhea and the stools of these individuals were cultured. In most instances the examinations could not be carried beyond placing the organisms in the *Shigella* or *Salmonella* group by biochemical means. One mild epidemic was caused by *Shigella ambigua* (Schmitz bacillus). No cases of dysentery due to *Shigella dysenteriae* (Shiga) and no cases of typhoid fever were seen.

The bacteriologic study of war wounds was limited. Many of the open wounds showed, on cultures, an organism of the *Clostridium* group as determined by morphological characteristics and the production of gas with cooked-meat media. It was not possible to determine the pathogenicity of these organisms and to place them in their proper type. There were 36 cases of clinical gas gangrene, all of which were treated with a combined type of antitoxin. Five of these patients died in spite of intensive treatment with antitoxin and sulfonamide drugs.

Due to the relative isolation of the island, only 35 patients showed urethral smears positive for gonococci, and many of these represented relapses and not acute infections. Only one darkfield examination was positive for *Treponema pallidum* and that was an individual who acquired his infection in the United States shortly before sailing. This would seem to indicate that there was very little, if any, syphilis among the native Melanesian women.

There were eight cases of clinical diphtheria from whom organisms of the diphtheroid group were isolated by smear and culture. These could not be checked for their toxin production by guinea pig inoculation, but all were given diphtheria antitoxin in therapeutic doses.

Only one case of purulent meningitis was seen. This was caused by an organism resembling the pneumococcus morphologically. Culture media were not available at that time. The patient recovered on sulfadiazine therapy.

There was one case of bacterial endocarditis from which a pleomorphic strain of *Streptococcus viridans* was cultured from the blood on several occasions. The patient was evacuated and subsequently died.

In the examinations of 1,740 stools for protozoa and helminths, only 47, or 2.8 percent, showed cysts or trophozoites of *Entamoeba histolytica*. This is not more than one might expect in other localities. There were 24 cases of hookworm infestation.

The stools of 6 Japanese prisoners were examined. Two of these showed ova of *Trichuris trichiura* and two showed ova of *Ascaris lumbricoides*. Other incidental findings were trophozoites of *Trichomonas hominis* and *Chilomastix mesnili* and cysts of *Giardia lamblia*. Only two of the stools were entirely free of protozoa and helminths on one examination. The stools of 17 natives, who were used as servants on the compound, were examined. Nine were negative for protozoa and helminths on one occasion, 7 showed ova of *Trichuris trichiura*, 4 showed ova of hookworm, 2 showed cysts of *Entamoeba histolytica*, and 1 revealed ova of *Strongyloides stercoralis*.

Several patients with suspected filariasis were thoroughly examined for the microfilaria in the blood stream, but none was found.

SEROLOGY

During the year, 2,836 blood Kahn tests and 178 spinal fluid Kahn tests were performed. Blood Kahn tests were run routinely on all colored patients admitted to the hospital, because it was discovered early that there were many undiagnosed cases of syphilis among the colored troops. All had histories or physical findings which dated the infections back to a time prior to landing on this island. There were 139 positive blood Kahn tests, or 4.8 percent of all Kahn tests run. Only 2 positive spinal fluid Kahn tests were found, and these patients

had other spinal fluid findings as well as clinical signs of central nervous system syphilis. In spite of the great number of cases of malaria in this hospital, it did not appear to confuse our serological findings except in a few instances.

Kahn tests were performed on 18 native servants on the station. Of these, 12 showed positive reactions. It is believed that this was a manifestation of yaws rather than syphilis. Kahn tests were done on the 6 Japanese prisoners with negative results.

GASTRIC ANALYSIS

A total of 293 gastric analyses were made during the year. The reason for this high number was the fact that a number of the patients entered the hospital because of chronic gastric complaints. All patients received an alcohol test meal, and those who showed an achlorhydria were given 0.3 mg. histamine as a stimulant. Samples were taken one-half hour and an hour after the alcohol meal or the histamine. Those who showed less than 20° free HCl during the test were classed as having hypochlorhydria, and those who showed more than 60° were classed as having hyperchlorhydria. In an analysis of 150 patients on whom gastric analyses were made, the following results were obtained:

	Percent
Achlorhydria.....	9 or 6
Hypochlorhydria.....	35 or 23
Hyperchlorhydria.....	16 or 10
Normal.....	90 or 61

Six of the nine patients with achlorhydria were also histamine-fast. Histamine was not available for the other three patients. This high incidence of achlorhydria and hypochlorhydria in the low-age group of the patients was rather surprising. Many of these patients had symptoms resembling those of peptic ulcer, and one had x-ray evidence of ulcer. Whether this low acid secretion is a result of life in the tropics cannot be definitely determined from this small series, but it is suggestive.

BASAL METABOLISM

There were 158 tests made for basal metabolism. Of these, 34 patients showed abnormal results, 14 patients were above plus 10 percent, and 20 patients were below minus 10 percent. The highest basal was a plus 41 percent in a patient with exophthalmic goiter, which was operated upon, the basal metabolism dropping to a plus 9 percent. The lowest basal was a minus 34 percent in a patient later treated with thyroid extract. His basal metabolic rate rose to a minus 8 percent.

BLOOD CHEMISTRY

There were 1,594 blood chemistry determinations, comprising 3 percent of the total laboratory work. However, 1,170, or 73 percent of these, were icterus indices, which were employed to follow the progress of the 320 cases of acute infective jaundice seen at this hospital. This was the most valuable single test available in the study of these cases, particularly in determining when a patient was able to return to duty. Bromsulfalein tests were done on many of these cases after their jaundice had cleared and no abnormal results were obtained, indicating that this type of jaundice probably leaves no appreciable residual damage to the liver. Only 2 cases of uremia, as indicated by a high nonprotein nitrogen, and 3 diabetics passed through the hospital during the year. Other blood chemistry tests available but not needed frequently were determinations for sulfonamide blood level, urea clearance, uric acid, plasma proteins, chlorides, cholesterol, creatinine, calcium, phosphorus, and alcohol.

SURGICAL PATHOLOGY

During the year there were 117 gross tissue examinations; 87 of these were on appendixes. The microtome did not arrive until late in the year, so all of the tissues were described grossly, and only the interesting or doubtful tissues were held over for microscopic examination.

POSTMORTEM EXAMINATIONS

Thirty-five postmortem examinations were held during the year, of which 27 were on hospital cases and 8 were performed on persons brought in dead. All patients who died in the hospital were autopsied. There was a gross mortality rate of 0.3 percent. Of these 27 deaths only 3 occurred on the medical service. One patient died of malaria complicated by postvaccinal hepatitis; another died of acute myocarditis; the third death was due to acute coronary thrombosis. These 3 deaths, occurring among —— medical admissions, gives a mortality of 0.06 percent. There were 24 deaths due to war injuries; 2 of these were due to burns, and 22 were due to shrapnel and gunshot wounds. With —— surgical admissions, this gives a gross surgical mortality rate of 0.6 percent. Among the admissions due to shrapnel and gunshot wounds, there were 22 deaths, a mortality rate of 1.3 percent. There were 2 deaths due to burns, a mortality rate of 2.2 percent.

The following is a list of the major wounds seen in these cases. Some patients died as a result of more than one major wound, so that

the number of cases listed below is greater than the total number of deaths:

Major wounds of the upper extremities, with compound fractures.....	4
Major wounds of the lower extremities, 4 with fractures.....	8
Fractures of the pelvic bones.....	4
Fractures of vertebrae.....	4
Fractures of clavicle.....	2
Fractures of ribs.....	2
Fractures of mandible.....	1
Fractures of skull, with brain injury.....	3
Perforations of stomach, intestines, or both.....	4
Perforations of bladder.....	1
Injuries to spinal cord.....	3
Injuries to chest and lung.....	7
Perforations of kidney.....	2
Perforation of spleen.....	1
Perforation of larynx.....	1

Five of the cases were complicated by gas gangrene, one by a staphylococcus septicemia, one by an acute nephritis with uremia, four with peritonitis, two with hemoperitoneum, four with hemothorax, and one with empyema.

BLOOD TRANSFUSIONS

A total of 250 blood transfusions were given at this hospital during the year. Most of the donors were hospital corpsmen. All had negative Kahn tests and had not had malaria. Two reactions due to mismatched blood occurred; neither was serious. One was due to carelessness on the part of personnel outside of the laboratory, and the other was so unusual that the case will be reported in detail.

CASE REPORT OF A TRANSFUSION PHENOMENON

A 24-year-old Navy lieutenant entered the hospital via ambulance plane, having been severely wounded in the right leg and thigh by shrapnel from aerial bombs 36 hours before. He had received two blood transfusions as well as plasma and dextrose at the field hospital at Base ——— prior to entry at this hospital.

He was in shock when admitted here and was given plasma, and an emergency transfusion was ordered. He was placed in group B because his cells were agglutinated by group A serum and not by group B serum. These sera were obtained from the United States Naval Medical School. His serum was found compatible with a group B donor from the donor's list, and he was given the transfusion without reaction.

During the following 3 days he was given plasma, dextrose, and a daily transfusion of group B blood, from three different donors, all of whom were compatible with the patient by matching their cells with his serum taken on the first day. The patient had no apparent reaction, but his condition remained very serious. Amputation of the right lower extremity was necessary. He

showed some hemoglobinuria. Then for 2 days he was given a daily transfusion of group O blood, because no more group B donors were available at that time. He began to show some improvement, and his hemoglobinuria cleared. The following day another group B donor was secured whose cells were compatible with the patient's original serum, which had been kept in the refrigerator. After receiving about 10 cc. of this blood the patient had a typical transfusion reaction. He became dyspneic and cyanotic, and he began to perspire profusely. His pulse became rapid, weak, and thready. The transfusion was discontinued, and the patient was given epinephrine. After a short period he quieted down and his pulse became regular and stronger.

Some blood had been removed from the patient just prior to the transfusion to use in future transfusions for matching. This fresh serum was now found to be incompatible with the group B donor with whose blood he had had this reaction and also to be incompatible with the four other group B donors who had previously given him the transfusions without apparent reaction. His fresh cells were now matched with the Navy typing sera and failed to show any clumping, and his fresh serum clumped the cells from both group A and group B individuals, thus placing him in group O. His health record revealed that he was originally placed in group O. The groupings of his original cells and serum were rechecked, and they were found to be group B, as originally determined. The groupings of both the original serum and the cells and the fresh serum and cells were repeated several times with different group A and group B sera and different group A and group B cells, and at both room and icebox temperature, with the same results. It was also found that his fresh serum agglutinated his own original cells. The patient was rechecked on several different occasions after the reaction, and he was always placed in group O. Antisera were not available for checking M and N agglutinogens or the Rh factor.

This man was apparently a group O individual whose cells showed B agglutinogens on entry into this hospital and whose serum agglutinins were so weak that there was no apparent reaction when he received blood from four group B donors. Then, after having received blood from two group O donors, he developed a reaction to a fifth group B donor. One explanation of cells with B agglutinogens in his original blood is that he had received blood from a group B donor prior to his entry here. This possibility was checked, and it was found that he was placed in group O at the field hospital by consulting his identification tag. Two unknown volunteer donors from a ship, also placed in group O, by consulting their identification tags, were used without retyping but by cross matching. These donors could not be rechecked because their names were not known. It still remains a possibility that this patient received some group B blood by mistake before entry to this hospital, and because of his condition his agglutinin titer was so weak that it failed to agglutinate the donors' cells either on cross matching in vitro or after the transfusion was given in vivo.

Q. EXPERIENCES IN THE X-RAY DEPARTMENT OF U. S. NAVAL BASE HOSPITAL ———

NORMAN J. BIRKBECK

Lieutenant Commander (MC) U. S. N. R.

The airplane is responsible for many changes in modern warfare. These changes penetrate into all departments of the Navy, including the Medical Department. The present-day advance base hospital can be located several hundred miles behind the scene of fighting in a relatively unmolested zone. This type of hospital can be substantially constructed and can be well equipped. Specialists in the various fields of medicine are provided an opportunity to practice in surroundings comparable to those in the best medical centers in the United States. U. S. Naval Base Hospital ——— is such a hospital.

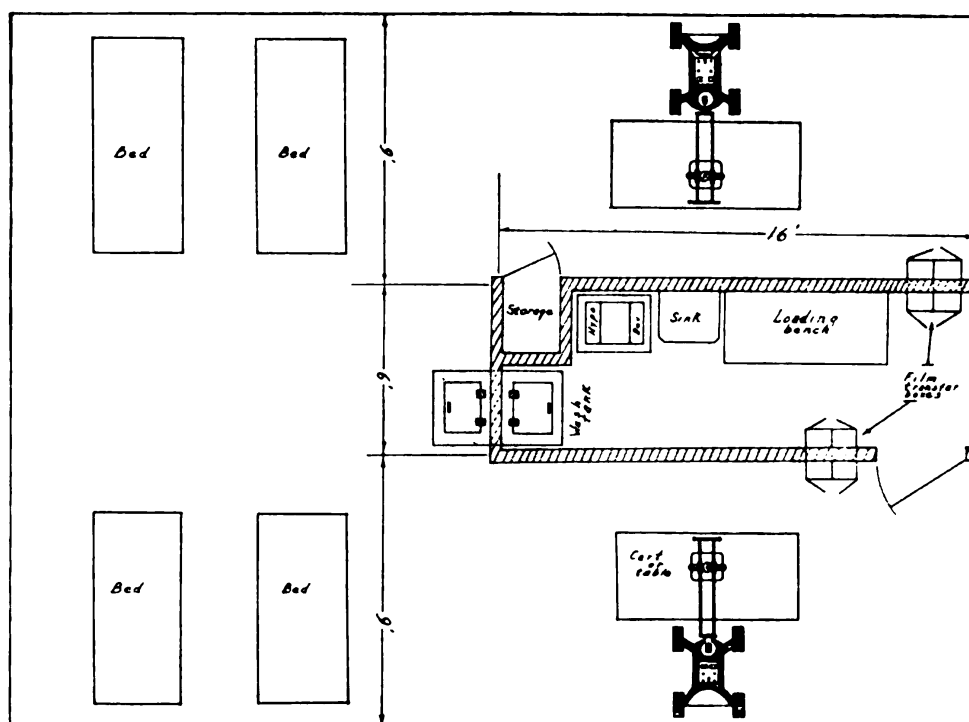
This hospital began to function during a large-scale offensive against the enemy in a group of islands located several hundred miles away. It was startling to receive large numbers of fresh casualties from such distant action. Most had received their wounds only a few hours before and had been given only first-aid treatment. These patients were brought to this base by ambulance plane.

Practically all required x-ray examination. It was an immediate necessity in many instances. These examinations were made by transporting patients to the x-ray hut directly from the receiving hut. This caused congestion, loss of time, discomfort to the patient, and the use of many corpsmen. At night, during a blackout, the hazards were increased. It became apparent that the receiving hut should be a large receiving ward, equipped with cots or hospital beds. Incoming patients can then be given emergency treatment, their wounds inspected, and requests for x-ray examination can be written. It also became apparent that an emergency x-ray department could be built into one end of the receiving hut. The arrangement of this department is shown in figure 1. This emergency x-ray department in the receiving hut should not be built at the sacrifice of the usual x-ray hut unless the hospital is destined to receive battle casualties for a long period of time or unless the size of the hospital is expanded to an extent requiring the use of two x-ray departments.

The Army field type or the large mobile type of x-ray equipment should be used in these x-ray rooms. Portable equipment is not rugged enough for this use. The more expensive type of combined

radiographic-fluoroscopic tilt table is not recommended, since this requires the transfer of patients to the radiographic table.

The majority of patients with war wounds cannot be moved without danger and discomfort. Hence, they are allowed to remain on the litters and wheel stretchers during the taking of the primary radiographs. Lateral films are made by placing the tube and film alongside the part to be radiographed. A thin wooden tunnel was constructed, with a fixed flat grid built into the top of the tunnel. This is placed under the litter or the patient when the thicker parts of the body are to be radiographed. This arrangement facilitates the easy handling of the patient and causes no discomfort in the majority of instances.



1. Floor plan showing two radiographic rooms with a darkroom between them, located in the end of a large receiving ward hut.

When great numbers of casualties are received at one time many require emergency treatment, and members of the staff desire to see the wet films as soon as possible. Frequent illumination of the darkroom to see films interfered greatly with the necessary expeditious examination of large numbers of patients. This problem was solved by constructing a wash tank which projected through the wall of the darkroom into an adjoining room. The tanks are enclosed, and hinged doors close the top of the tank in both the darkroom and the adjoining room. The films are placed in a square rack and slid on narrow rails through the water from the darkroom to the adjacent room. The wet films are then viewed in the adjacent room and are also dried in this

room. This made it possible to remove much equipment from the darkroom and to make the darkroom much smaller. By a similar arrangement it would be possible to build a small darkroom between the two radiographic rooms in one end of the receiving hut. Wet films can then be viewed by the staff in the receiving hut, and the patients can be sent to the operating rooms or the appropriate huts.

The problem of localizing foreign bodies was troublesome at times. In general, simple measures were employed. Most of the metal fragments were shrapnel. They usually lay superficially or were partially exposed in the wound. It was usually sufficient to take films from the frontal and lateral projections, whereby an estimate of their position could be made in relation to a fractured bone or a large open wound. Fluoroscopy was used frequently for the purpose of placing a mark on the skin directly over the fragment of metal. The policy of the surgical staff was not to remove many of the small metal fragments, so no localization was required in such cases.

Metal foreign bodies in the eye were very difficult to localize. The patients usually had other wounds, and often there were splints on the arms or legs. These patients had to be examined in the recumbent position. A method of fixation of the head was devised as follows:

A small cassette was made of a plastic box. This box had a screw cap, and by the use of a ribbon spring a film was held with slight compression between two screens in the box. Wire frames were constructed to hold the cassette in the frontal and lateral positions. A fine wire loop was made approximately the size of the circumference of the cornea. After the eye was cocaineized the wire loop was placed on the surface of the eye at the limbus of the cornea. It remained in this position by the force of gravity. The diameter of the wire loop was 13 mm., so that any degree of distortion could be calculated from this known diameter.

This method was not satisfactory when the skin of the face about the eyes contained many pieces of metal. In such cases the metallic fragments became superimposed over the orbits, so that the foreign bodies in the orbits could not be distinguished from the foreign bodies in the face. The most satisfactory method of localizing foreign bodies in the eye is offered by the Sweet eye localizer (Victory model). This also allows the patient to be examined in the recumbent position, and the calculations are not distorted by neighboring bits of metal in the soft tissues.

It was found necessary to make another deviation from the original plans for the x-ray laboratory. This involved the transfer of the film reading room from the x-ray hut to a quiet room, located in one end of an adjacent ward hut. This was done to avoid frequent interruptions by members of the staff and members of the x-ray department, and facilitated the production of the long, descriptive reports required in many instances, particularly in war casualties.

R. ACTIVITIES OF THE DENTAL DEPARTMENT OF U. S. NAVAL BASE HOSPITAL ———

LAWRENCE F. PATTERSON

Commander (DC) U. S. N. R.

ELMER HARTWIG

Lieutenant Commander (DC) U. S. N. R.

and

JACOB I. ESSIG

Lieutenant (DC) U. S. N. R.

The dental clinic at United States Naval Base Hospital ——— is installed in a separate hut which includes a waiting room, prosthetic laboratory, and a dental operating room. The most modern and efficient equipment has been provided; this comprises four Ritter chairs, four large Ritter units, four American cabinets, and one Weber dental x-ray unit. Every opportunity, therefore, has been offered for the production of work comparable to that of the most modern dental offices in the United States.

The care of battle casualties has been a major problem. Patients were treated both in the wards and in the dental clinic. Forty-four fractured jaws were reduced, 29 of which resulted from gunshot wounds. Most of the fractures involved the mandible. The recognition of a fractured mandible may not always be possible from physical examination alone. Often, diagnosis is made solely by x-ray findings. However, most of the patients with such fractures revealed some or all of the following signs and symptoms: Discoloration, swelling, pain, and tenderness over the area of the fracture; partial loss of motion and severe pain when movement is attempted; often a drooling of saliva due to traumatic irritation of the salivary glands as well as conscious effort on the part of the patient to avoid the painful performance of swallowing; marked malocclusion, with an open bite and the presence of crepitus when an attempt is made to correct the malocclusion by manual pressure; deviation of the jaw from its normal position to the side of the fracture in which the inferior dental artery has been severed; or lacerated gingiva, loosened teeth, and bleeding from the sockets of teeth knocked out by trauma or from lacerated mucous membrane.

All patients with jaw fractures were given a course of sulfathiazole treatment. Whenever cellulitis occurred, the use of x-ray therapy in 75-100 r doses was employed. No attempt was made to wire a jaw before debridement of other wounds had been accomplished. In cases

of comminuted fracture, conservative treatment was practiced. No patient developed gas gangrene.

The officers of the dental department collaborated with the staff of the eye, ear, nose, and throat department in the immobilization of the reduced fractures of the maxilla and mandible. Acrylic splints were constructed to hold the fragments in position, and these in turn were held in place by an attachment to a plaster skullcap.

The following is a summary of the total work accomplished during the first year of operation of the dental department: There were 7,368 chair sittings, 3,220 fillings, 982 extractions; 94 impacted teeth were



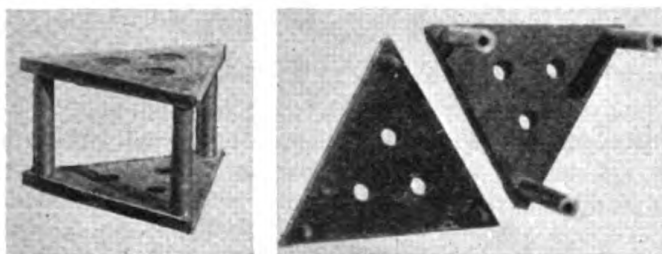
1. Dental Department, United States Naval Base Hospital ———.

removed, 1,620 x-ray examinations were made, and 44 jaw fractures were reduced.

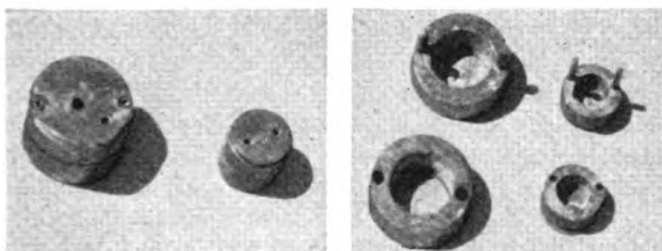
Due to the lowering of the dental requirements for admission into the armed services, the need for tooth replacements has become a major problem. In addition to this, men lose many teeth or dental prostheses through accidents and war injuries. All of these individuals must be provided with some type of denture, whether it be a partial plate, a full plate, or a bridge. Individuals who are rendered unfit for duty because of the need of denture prosthesis may appropriately be termed "dental casualties."

Oral discomfort, due to a lack of denture prosthesis, has an injurious influence on the central nervous system and may result in

general organic dysfunction. Many patients are restored to health by the oral comfort which is made possible when competent prosthetic service is rendered. Many of them are relieved of deafness, trismus, vertigo, reflex facial pain, headaches, and burning sensations of the tongue caused by improper maxillomandibular relationship or disharmony of the teeth in function. As a result of the lack of the necessary denture prosthesis, self-consciousness and an inferiority complex contribute to the individual's lowered morale. The restitution of lost dental organs has a tendency to add a new incentive to life, and the man returns to his place of duty as an integral part of our fighting forces.



2. Duplicator, constructed of two pieces of flat mild steel and two triangles, 5 inches on a side. Pins were made of $\frac{1}{2}$ -inch brass with tapered pins of $\frac{1}{4}$ -inch mild steel bar.



3. Flasks constructed of bronze and welding rod pins.

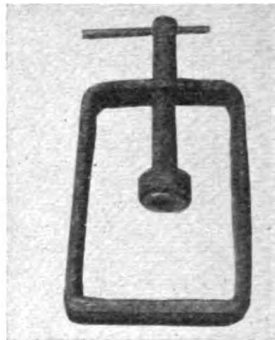
What can the dental officer do to render this needed type of service at an advance base hospital? Should he stand idly by and tell the patient that a laboratory has not been established or authorized and that there is no equipment to do this type of restorative dentistry? Should he send away the men who come in requesting partial dentures, full dentures, or the repair of broken plates with the excuse that nothing is available to render this service? At this base hospital the great need of aiding these unfortunate individuals was recognized, and consequently ways and means of doing this type of work were devised, despite the lack of certain specialized equipment and facilities.

A section of our clinic was devoted to the construction of a prosthetic laboratory, 21 feet by 7 feet in size. A machinist's mate was detailed to construct flasks, duplicator, hinge articulators, and bench

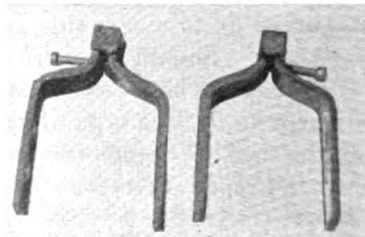
presses. A lathe was constructed from the motor of a broken-down flour sifter, and a vibrator was made out of an A. C. vibrator coil with a vibrating table mounted on a spring which was inserted into a base of an empty 75-mm. shell. The table top was made from a piece of aluminum taken from an airplane which had crashed. The



4. Casting bracket constructed of 2-inch copper tubing with chain and handle of cold round steel.



5. Clamp press constructed of mild strap steel with $\frac{1}{2}$ -inch bolt with swivel head on it.



6. Articulators constructed of cold strap steel with screw.

accompanying photographs illustrate the types of equipment which were constructed. When naval vessels came into the harbor, a visit was made to the dental officer in charge to obtain acrylics, teeth, etc. Gradually enough supplies were accumulated to meet the needs of a considerable number of prosthetic cases. The advent of acrylics has

made the construction of dentures quite simple, since a vulcanizer is not essential. The following work has been done as a result of this enterprise: 30 gold inlays, 16 bridges, 8 crowns, 56 dentures (full, partial, and intermediate), and 62 repairs of broken dentures. It is apparent, therefore, that a needed service was rendered to men who would otherwise have been seriously handicapped in the performance of their duties. By this means it was possible to return many men to the front directly from this advance base hospital, rather than evacuating them to distant bases or to the United States.



DILATATION OF STOMACH

The prevalent opinion is that acute postoperative dilatation of the stomach generally follows upper abdominal surgery, and that it is very amenable to treatment. Such, however, is not the case. Acute dilatation of the stomach may follow almost any type of operation in any part of the body. All methods of treatment, hitherto advocated, may be unsuccessful.

A new treatment advocated consists of gently lifting the patient out of bed and supporting him in an erect position for approximately ten minutes. He should be encouraged and aided in taking a few steps. This maneuver should be repeated after a two- or three-hour interval in those cases that do not respond satisfactorily or completely to the first attempt.

This new form of treatment has been effective in saving the lives of all six of the writer's cases in which death seemed to be imminent from the dehydration and toxemia caused by the incessant and uncontrolled vomiting of postoperative acute dilatation of the stomach.—Joseph, E. G.: A new treatment for acute dilatation of the stomach. *Am. J. Surg.* 60 : 381, June 1943.



TENSENESS AND GASTRIC SPASM IN FLUOROSCOPIC EXAMINATION OF THE STOMACH

Tenseness and so-called gastric spasm is a major problem in fluoroscopic examination of the stomach in military personnel.

Drugs for the relief of gastric spasm, such as atropine, physostigmine, and benzedrine have been suggested.

Kirklin has suggested that obtaining the patient's confidence, and the manner of handling the patient are important.

The following methods have proved of value:

- (1) Have the patients placed in chairs in the fluoroscopic room about 5 to 10 minutes prior to examination. The lights are to be dimmed. If there are several patients, several chairs can be used and new patients added from time to time.

- (2) Encourage the patient to relax by engaging him in conversation and making him realize that you have a personal interest in his case.—Hilt, Laurence M., Commander (MC) U. S. N. R.

THE TREATMENT OF BURNS

A DISCUSSION BASED ON EXPERIENCE WITH 300 CASES
SEEN ON BOARD A U. S. HOSPITAL SHIP

RICHARD A. KERN

Captain (MC) U. S. N. R.

ROBERT F. NORRIS

Lieutenant Commander (MC) U. S. N. R.

HUGH MONTGOMERY

Lieutenant (MC) U. S. N. R.

ROBERT S. WIGTON

Lieutenant (MC) U. S. N. R.

LEWIS K. FERGUSON

Commander (MC) U. S. N. R.

and

ROBERT B. BROWN

Lieutenant Commander (MC) U. S. N. R.

The treatment of burns constitutes an important problem at all times; but in warfare, and particularly in naval warfare, that problem assumes major importance. For in naval actions, burns may account for a high percentage of casualties (for example, 60 percent at Pearl Harbor (7)), due chiefly to flash burns from explosions of powder, bombs, torpedoes, and projectiles, especially in enclosed or partly enclosed spaces. Added hazards are conflagration of inflammable liquids, other fires in ships and planes, burning oil on the sea, escaping steam and scalding water, exposed and broken electrical circuits, friction (resulting notably in burns of hands, arms, and legs when men slide down ropes, as in abandoning ship from the flight deck of a carrier), chemicals, vesicant war gases, and overexposure to the sun (in shipwreck). Furthermore, the importance of the treatment of burns is augmented and its fulfillment complicated in naval medical experience by the need for applying treatment to large numbers of patients in limited spaces, with limited help and materials, and often under the difficult conditions of battle.

Medical literature has been flooded in recent years with articles on the treatment of burns, often without sufficient justification. We therefore wish to state at the outset the reasons which, we feel, justify our publication.

A large proportion of the articles on the treatment of burns are open to one or more of the following criticisms: The writer commonly extols the merits of a single method of treatment, applied to a

small number of patients. In many instances the experience of the writer has been limited to a single type of burn, or limited as to the extent (surface area involved) or depth of burn. In some cases his experience has been largely limited to a stage of the burn, as in cases of burns seen only during the first few days, the patients then being transferred elsewhere and so not followed to the end of their course. From such limited data and part truths based on a particular mode of treatment or a particular type of burn, many authors have committed the error of drawing too generalized conclusions as to the whole field of burn treatment. Some, fortunately in lessening numbers, still think too much in terms of the treatment of the local lesion and too little in terms of the patient as a whole.

We have had the opportunity to see on this ship an unusual number and variety of cases of burns. In the past 12 months there have been under our care some 360 patients, victims of one or more of all the types of burns enumerated in the opening paragraph except those due to vesicant war gases. They have presented every degree of extent and depth. Some have come to us as early as minutes after being burned, others at intervals up to several weeks later. Their treatments were inaugurated in some instances by ourselves; in the majority, however, by many other medical officers. The methods of treatment employed have included nearly every one that has been recently proposed; and, in addition, there have been examples of various and strange combinations of different methods applied to the same patient. Although, unfortunately, we have been unable to complete the treatment of most of these cases, since we transferred most of the patients to shoreside facilities, we nevertheless have been able to follow up most of them at later visits to those facilities.

We have, therefore, seen the results of various methods of treatment in many examples of a wide range of burn cases, both as to cause as well as extent and degree, and at all stages of their progress. In the light of this experience, we feel justified in presenting our views.

Treatment requires observance of certain fundamental principles. Burn patients do not die of their burns; they die as a result of systemic changes which the burns induce, notably shock, toxemia, and sepsis. Therefore, the first principle is a clear concept of the pathology and altered physiology involved. A majority of burn cases, to be sure, since they are not sufficiently extensive, do not produce any considerable general derangement. Such patients get well, no matter what treatment is used. (Yet often on results in such simple cases are based the claims for certain forms of treatment.) But in severer cases the burn produces rapid and profound changes in the body as a whole that will end in early death, unless they are prevented, or recognized, measured, and treated promptly and with meticulous thoroughness. In such severe cases, too, the local treatment itself is not without dan-

ger; as, for example, liver necrosis from absorption of tannic acid or renal damage from sulfathiazole used locally as well as internally.

Judgment in the selection of local therapeutic measures is likewise of fundamental import, not necessarily as to life or death, but certainly as to the promptness and completeness of healing. It must take into account a number of factors: The nature of the burn, its extent and depth, the part of the body involved, the general condition of the patient, the time that has elapsed since the burn was incurred. Of major practical importance in this regard, too, are the number of cases concerned and the circumstances under which they must be treated. If a large medical staff and unlimited materials are available, the choice of method of local treatment might be quite different from that resorted to when one man must treat many cases in an emergency.

Burns are, of course, always emergency affairs. Therefore preparedness to treat all types of burn cases is essential to insure the best results.

THE PATHOLOGICAL PHYSIOLOGY OF BURN PATIENTS

Shock is the greatest single cause of death, accounting for from 60 to 75 percent of all fatalities in burn cases. A clear understanding of its mode of causation, prevention, recognition, and treatment is therefore of paramount importance.

In the mechanism of the production of shock in burn cases there are involved a number of factors, some of which are well-established, others not so well understood. These factors deserve discussion in some detail, since the importance of each must be evaluated in the individual case and must be considered in the treatment of that patient.

The nervous and psychologic factor rates first consideration. Pain is the most expressive single term that is here applicable, but the concept also involves fright, apprehension, and the nervous fatigue after frantic overexertion. This factor is undoubtedly the earliest cause of shock (often called primary shock) and is in some degree undeniably present in every case. It is augmented by nearly everything that happens to the patient, including, often enough, the treatment applied. It is conditioned to some degree by the temperament of the patient. It is decidedly influenced by the site of the burns: involvement of the face, abdomen, and genitalia will lead to death with much smaller total areas affected than when these parts are not involved.

Loss of fluid from the circulating blood, resulting in hemoconcentration, is the most important cause next operative in producing shock during all of the first 24 hours and commonly for 48 hours after the burn (secondary shock). The recognition of this factor by Underhill and his associates in 1923 (17) is perhaps the outstanding single advance in our knowledge of the mechanism of shock in burn cases, for

it has led to the use of plasma intravenously to counteract the hemoconcentration. Fluid loss begins almost immediately and continues, depending on the area and depth involved, for 1 to several days. Allen and Koch (2) have applied the apt term, "white hemorrhage" to the process.

The amount of fluid lost from the circulation in a very short time is amazing. Blalock (4) has shown that it equals 50 percent of the blood fluid volume in animals that had a burn involving one-half of the body surface. Underhill (17) has observed a loss of 70 percent of the blood fluid volume. As much as half the fluid loss may occur in the first 6 hours.

Fluid loss is due to increased capillary permeability, which in turn is the result of several factors. Chief of these are the local effects of heat on the tissues, nervous influences, and in the later stages, probably also anoxia incident to inadequate circulation, and the absorption of toxic products (histamine ?) from the burned areas. The importance of nervous impulses to and from the burned area as a factor in the production of increased capillary permeability has been pointed out by Kabat and Heden (11). After transsection of the cord at the first lumbar segment, but with the autonomic nerve supply intact, they demonstrated a lesser fluid loss in the burned area and consequently less hemoconcentration than that in control animals with lower-extremity burns of the same degree. These nervous influences, which were demonstrated in animals under barbiturate anesthesia, might well be more active in the unanesthetized patient. Sensory impulses can thus be a factor in the production of secondary as well as primary shock and therefore demand constant attention in the treatment of these patients. As hemoconcentration proceeds and blood volume diminishes, the transport of oxygen to the tissues becomes less efficient and the resultant anoxia becomes an added factor in producing a generalized increase in capillary permeability and further fluid loss. Then there is the possibility that fluid loss may be enhanced by the absorption of histaminelike substances from the burned area.

Where does the fluid loss occur? It occurs overwhelmingly in the burned area, first as edema due to increased capillary permeability produced by the direct effect of heat, then continued as blister formation and oozing. To be sure, some of the fluid loss can and does occur in other than the burned areas as a result of factors acting on the circulation generally, such as anoxia and histaminelike substances. But these appear later and probably to a much less degree. The burned area therefore contains much, probably most, of the lost fluid.

To what extent such localized cutaneous edema can in a few hours deplete the water content of the blood may be better appreciated in the light of known facts as to the distribution of body water. Normally not over 8 percent of body water is in the circulating blood.

But 20 percent of body water is normally present in the skin. In other words, two-fifths of the skin contains as much water as does the whole quantity of the circulating blood. Let us suppose that an individual sustains a burn involving two-fifths of his body surface and that through edema of the burned area this part of his skin in the course of 2 or 3 hours has its water content increased by half. That would reduce the water content of his blood by half. Yet a burn of that extent and such an edema are common enough as serious burn cases go.

This matter of the mechanism and site of fluid loss is of more than mere academic interest. Clinicians have been inclined to think chiefly in terms of total fluid lost as shown by hemoconcentration, with a view to treatment by fluid replacement. We believe that certain measures, notably pressure bandages over burned areas, applied early, will prevent some of the fluid loss and so will to some degree prevent the development of shock.

The absorption of toxic products is probably also at times a factor in the production of shock, although its relative importance is still debatable. We are not prepared to assign a value to this factor, for it may be extremely variable, but we should like to cite some evidence to show that it might loom large in certain cases:

1. The damage to certain internal organs and tissues (e. g., kidney and liver changes, Curling's ulcer) seems to be directly proportional to the size of the area burned and so probably to the possible degree of absorption of toxic substances.

2. Vogt (18) showed that in guinea pigs there was an increased histamine content in the burned skin and that prompt excision of the burned area saved such animals from fatal shock.

3. The treatment of burns by various coagulants of protein, such as tannic acid, is based in part on preventing such absorption, and the undoubted improvement in the results of burn treatment by these methods may be considered in part as confirming this hypothesis.

4. That absorption can take place from the burned area is shown clinically in one of our patients with burns involving 75 percent of his body surface; 40 hours after the application of a 5-percent sulfathiazole ointment there was a blood level of 7.8 mg. of sulfathiazole per 100 cc., and there were sulfathiazole crystals in the urine.

5. Wells, Humphrey, and Coll (19) found that if rats were injected intramuscularly with tannic acid, the liver showed changes (essentially a central lobular necrosis) that varied in degree with the dose of tannic acid and were like those found in the liver in patients dying of burns treated with tannic acid.

Shock may at times be accentuated by other contributory factors, such as acidosis and shifts in electrolytes. However, these are at

most minor and rather late factors in the mechanism of shock production and may never be present in patients who succumb rapidly to shock.

On the other hand, in extensively burned patients, they may become more marked during the third to sixth days, a period that has been called the stage of toxemia. Probably the chief factors in the causation of toxemia are absorption of toxic matter from the burned area and the changes in the composition of the blood following the loss of plasma. Toxic absorption may also involve materials used in local treatment, such as tannic acid and sulfonamides. The term "toxemia" is vague, and the picture to which it is applied may embrace several components. A shift of electrolytes is commonest. As Tenery (16) and Lam (12) have shown, this is usually characterized by a fall in plasma sodium and chloride and a rise in plasma potassium. An acidosis, usually of minor degree, may be demonstrable in a reduced CO_2 -combining power. A fall in serum protein can further complicate the picture. These changes are initiated by the plasma loss and increased by the subsequent hemodilution that results when, after the first day or two, the patient drinks huge amounts of liquids. Renal insufficiency, at times to the extent of anuria, will produce the urine and blood changes usual to that condition. It is more likely to develop in patients in whom vomiting interferes with fluid intake.

Not only is sepsis, after shock, the most important cause of death, but the local infection to which it is due is also a cause of additional destruction of living epidermis and of delayed healing. Sepsis is due to infection arising secondarily in the burned area. It may appear as early as the fourth or fifth day, and it may be a threat far into convalescence, so long as an infected burn lesion remains. The infection is chiefly due to contamination through attendant personnel (droplet infection from nose and throat; unsterile hands, dressings, and instruments), to a lesser degree to attendant circumstances (trauma; gross contamination with clothing, fuel oil, etc). Burned areas are rendered sterile by the heat which produces them, and they tend to remain so during the first 12 hours.

Once infection has developed in any part of a burned area, it becomes a threat of further infection elsewhere in the body, not only in other burned areas or tissues subjacent thereto but in other parts of the body as well. Such extension of infection in its most serious aspects is not merely by contiguity or surface transfer but by blood-borne dissemination.

Therefore the early recognition and treatment of infection under a therapeutic eschar are matters of serious importance.

The diagnosis of shock, toxemia, and sepsis deserves a few comments. In the recognition of shock, probably the earliest sign is

an unusually rapid pulse rate. Then a low blood pressure is helpful, but unfortunately a blood pressure reading is often not available because of burns that interfere with the application of the cuff. Then there are the evidences of hemoconcentration, of which the most easily obtainable is a rising percentage of hemoglobin. The patient's appearance may help, but varies; the skin is usually moist, but the face may be pallid or flushed. Experience here is more helpful than mere description.

In the stage of toxemia the simplest clinical aid is the examination of the urine, which discloses albumin, casts, and erythrocytes in the order mentioned and in quantity increasing with the severity of the toxemia. When obtainable, the finding of lowered levels of blood chloride, protein, and CO_2 -combining power and of elevated nonprotein nitrogen figures is helpful. The patient is febrile, flushed, with a dry skin and a dry, coated tongue.

The possible onset of sepsis is heralded by the obvious infection of the burned areas, an accession of fever, and a rise in the leukocyte count. The clinical picture is too familiar to need further description.

Classification of burns.—It is undoubtedly true that the area of the burned surface is more important than is the depth of the burn, from the standpoint of the survival of the patient. But depth cannot be ignored, and from the standpoint of the duration of incapacity of the patient it is of prime importance. It has been customary to classify burns as first degree (erythema), second degree (vesication), and third degree (destruction of epidermis). Unfortunately, it is impossible in most cases to tell at the onset just how deep a burn really is. The commonest error is to think that a severely burned area is only of first degree, but the mistake can also be made in the other direction. Fortunately, it does not matter greatly how deep the burn is, when it comes to instituting treatment.

To the last statement, however, there is one exception: Burns that extend into the subcutaneous fat and beyond should not be treated by a number of methods, to be mentioned later. It would seem wise for descriptive purposes, therefore, to distinguish between a burn that does not go deeper than the skin (third degree) and one that does, with involvement of subcutaneous fat and even deeper tissues (fourth degree).

Although it may be difficult to tell in the individual case just how deep the burn is, yet a knowledge of the depth of burn that a given type of cause of burns usually produces is often helpful. In our experience, flash burns are almost never fourth degree, and they occur, of course, only on uncovered body surfaces. At times, however, third- or fourth-degree burns are seen in these patients in the region of the wrists and above the shoe tops, where antishock clothing

has caught fire and burned the skin where it was not protected by sleeves or trousers. Electrical burns, on the contrary, are almost invariably fourth degree and are also most frequent on uncovered parts. Burns due to steam or hot water are usually second, third, or fourth degree, are usually worse on covered parts, and worst where the greatest thickness of clothing holds the heat longest. Similarly, burns due to ignited gasoline or fuel oil tend to be deepest, often fourth degree, where the gasoline- or oil-soaked clothing continues to burn, while the face often escapes with first- or second-degree burns. The *hands* are variously involved: In pure flash burns the dorsal aspect is most affected, while the palms usually escape. When clothing is ignited, all surfaces of the hands suffer greatly as a result of the attempts to beat out the flames. Nothing is quite so striking as the complete protection which the wearing of gloves affords to the hands. No burns are as crippling as those of the hands, even the smallest. Therefore we cannot emphasize too strongly the importance of wearing gloves when that is possible and when burns are likely to be incurred, as in fighting fires or during action. The almost instantaneous functioning of the wink reflex protects the eyes in the great majority of instances. Burns of the lids are therefore about as common as face burns, but involvements of cornea and conjunctiva are uncommon, usually of minor degree, and heal promptly and completely. The chief exception is furnished by the occasional patient who is unconscious and with eyes open at the time of the flash. Even then the lesion of the cornea is likely to be below the level of the pupil.

PRINCIPLES OF TREATMENT

In the light of the foregoing, certain general principles of treatment may be outlined. Primarily there are involved (*a*) the prevention and treatment of shock and (*b*) the prevention of toxemia and sepsis. Secondarily there arise (*c*) the treatment of possible subsequent complications, notably toxemia, infection, anemia, and damage to internal organs, and (*d*) the management of granulating surfaces, including skin grafting.

The prevention and treatment of shock include (*a*) the relief of pain, (*b*) the prevention of fluid loss, (*c*) the replacement of lost fluid, and (*d*) the conservation of body heat.

Psychic and nervous factors are the earliest causes of shock, and continued pain rapidly increases shock. Therefore the immediate control of pain by morphine is called for. The initial dose in most severe cases should be one-half grain hypodermatically, with subsequent doses of not over one-fourth grain as indicated. Under military conditions, two points are of outstanding importance: First, the use of Syrettes for giving morphine; and second, the immediate

recording, on a tag attached to the patient, of the amount given and the time of administration. Such tags in blank form should be a part of standard preparation for the management of burn cases. A spring clip of the type used by laundries or dry cleaners is a convenient means of fastening the tag to clothing or dressings. The same tag may be used to epitomize other treatment given, such as name of sulfonamide or other drug used locally, tetanus toxoid or antitoxin, gas gangrene prophylaxis, etc. In the absence of a tag, a skin pencil or dye solution may be used to record the data on the unburned area. If this is not done, there is grave danger that a fatal overdose of morphine may be given to a patient who has been rapidly evacuated into the care of another medical officer. It is worth repeating that not more than one-fourth grain at a time should be given to a patient who has received any previous doses of morphine.

Attempts to anesthetize the burned area just before undertaking the local treatment are time-consuming and not sufficiently effective to justify their use.

The prevention of fluid loss is not usually taken into account by those who discuss the treatment of burns, nor is there any very effective means by which that may be fully achieved. Yet we are sure that something can be accomplished in this direction, and whatever is so accomplished is that much gained for the patient. Briefly, the mechanical effect of pressure on a burned area will in some degree hinder the development of edema. Undoubtedly in many instances, especially in burns that involve the full circumference of an extremity, rapidly applied tannic acid exerts considerable pressure and so permits the development of less edema than would have happened in the absence of the tan. But a much better effect, we believe, can be achieved by the snug application of an elastic bandage on the whole of a burned extremity, such bandaging to be done immediately after and over the definitive dressing on the burn area. How often such as acidosis and shifts in electrolytes. However, these are a fact that 333 of our 360 patients had some burns that involved an extremity. In the case of burns of the trunk such bandaging is not feasible, yet we believe that a snugly applied scultetus binder can exert some helpful pressure.

Even after the development of edema in a burned extremity, the application of a pressure bandage is nevertheless called for. Limbs so bandaged showed an early subsidence of edema and a corresponding improvement in the condition of the burn itself.

The administration of adrenal cortical extract (eschatin) is helpful in controlling fluid loss. Rhoads, Wolff, and Lee (15) recommend 5- to 10-cc. doses intravenously every 6 hours during the first 2 or 3

days. Heuer and Andrus (10) showed experimentally that it reduced the permeability of capillaries in the shock produced by the injection of extracts from closed intestinal loops. We have the clinical impression that eschatin is helpful in these cases but had too small a supply to give it a thorough trial. It is most effective if given intravenously and early. Please note, however, our later comments on salt administration to patients also being given eschatin.

The replacement of lost fluid is of the greatest importance. To be most effective, the fluid used for replacement should approximate in its composition the fluid which was lost, namely, plasma. It is not our intention to consider the relative merits of dried plasma versus wet plasma. They do not materially alter the basic principles of fluid replacement. Nor have we any experience with serum albumin preparations, which, in addition to supplying the chief factor in producing the osmotic pressure of the blood, achieve by reason of their hypertonicity a withdrawal of fluid from intercellular spaces (edema) into the blood vessels.

The first point in fluid-replacement therapy with plasma is the determination of the dose to be given. The aim is to introduce enough plasma into the circulation to replace quantitatively the amount of fluid that has been lost. The amount required is calculated from the degree of hemoconcentration which the patient shows. In a hospital and with a small number of cases to treat, this can be determined accurately by the hematocrit; but under battle conditions or with many cases under treatment, this is not practicable. Experience has shown, however, that in early burn cases, before much fluid has been administered by mouth or vein, the careful estimation of the hemoglobin by a good clinical method such as the Sahli (we have used chiefly the Haden-Hausser instrument, at times that of Duffie) suffices for practical purposes. The Tallqvist method is not satisfactory for obvious reasons. (Later, when changes other than hemoconcentration may have arisen, the determination of the plasma protein level, the CO₂-combining power, and chloride level are desirable aids to further treatment.)

It has been our custom to give plasma according to the following table, posted in the wards of this ship. As suggested by Black (3), the figures are based on the assumption of an average normal blood volume of 5 liters, and the plasma doses are given in multiples of 250 cc., the content of a standard container unit of plasma. We have, however, assumed 95 percent as the usual normal hemoglobin, rather than 100 percent. Hemoglobin estimations are made every 6 hours during the first 24 hours and as often thereafter as indicated.

TABLE 1.—*Plasma dosage calls for—*

Hemoglobin (percent) :	Plasma dose
90-----	0 to 250 (0 to 1 unit).
95-----	250 (1 unit).
100-----	500 (2 units).
105-----	750 (3 units).
110-----	1,000 (4 units).
115-----	1,500 (6 units).
120-----	1,750 (7 units).
125-----	2,000 (8 units).
130-----	3,250 (9 units).

If hematocrit readings are used for estimating the degree of hemoconcentration, then the plasma dose may easily be calculated by Harkins' (8) simple rule: 100 cc. of plasma for every point by which the hematocrit reading exceeds 45.

A practical point in the use of dried plasma is worth mentioning. It occasionally happens that the vacuum in the dried-plasma container is lost wholly or in part when the needle is first inserted, so that the water will not be aspirated out of its flask into the plasma flask. If a cloth wrung out of hot water is wrapped around the base of the inverted water flask, sufficient positive pressure is developed by the expansion of the air bubble to force some water into the plasma flask. By alternating this maneuver with cooling of the water flask, the water can all be forced into the plasma flask.

A practical point in the administration of fluids to these patients is that plasma, blood, and other liquids that must be given parenterally can be given into the medulla of the sternum, even though the skin over that region is involved in the burn. The only special equipment needed is a sternal-puncture needle: 15-gage, $1\frac{1}{8}$ inches long, short-beveled, and provided with a stylet.

The conservation of body heat has been unduly emphasized in the past, or, rather, has been too enthusiastically employed by interfering with heat dissipation in the presence of fever, or by actually raising body temperature with blankets, light cradles, and hot drinks. Blalock and Mason (5), in studies in experimental shock, have shown that animals which were kept warm had a shorter survival time than did controls not so warmed. The coolness of the body surface in these patients is probably in part a compensatory mechanism to conserve fluids and sustain blood pressure by peripheral vasoconstriction. To keep these patients too warm only results in further fluid and salt loss, since they rapidly become bathed in profuse perspiration. Moreover, a high environmental temperature inhibits heat dissipation from the body. In patients with extensive burns covered with an occlusive dressing, a very small normal surface remains to carry out this important function, which may already be overtaxed by fever.

On the other hand, it seems equally fallacious to let the patient suffer from cold. And suffer they do, and promptly, as with chattering teeth they ask for blankets. Therefore, actually to refrigerate these patients, as has been suggested in one quarter, seems outright folly.

The optimum temperature, it seems to us, lies somewhere between these extremes of sweating and shivering. In short, it is the range of comfort, and inclines to be somewhat on the cool side. Only with extensively burned patients—that is, when ordinary bed clothing is impracticable—do we use a light cradle, and with only one or two lights turned on. As soon as a patient shows any perspiration or says he feels warm, the lights are turned off. As soon as he complains of cold they are turned on again. The range between these extremes is so narrow that frequent attention by a responsible person is required to control the cradle lights. We have made it the duty of the nurse on the burn team.

The prevention of sepsis.—Burns, by the very reason of their origin, are primarily sterile. As Aldrich (1) has shown, they tend to remain sterile for about 12 hours. Since most burn patients are first seen within that interval, the problem is essentially one of maintaining asepsis in treating and dressing a sterile wound. The organisms most commonly found in burns that have become infected are streptococci and staphylococci (Aldrich (1), Clark and Cruikshank (6), and Marsh (13)). The most likely source of these organisms is the nose, throat, and fingers of those attending and around the burn patient. The implications are obvious: Those who come in contact with the patient during his primary dressing should wear masks; should wash their hands thoroughly; and, under circumstances, should wear sterile gloves. An aseptic technic should be maintained in all stages of the primary and subsequent dressings of these patients.

The use of a bacteriostatic agent, such as a sulfonamide, or of an antiseptic in the definitive treatment will help prevent a threatened infection or clear up an incipient one. The internal administration of sulfonamides as a safeguard against infection has been generally advised. This may well be indicated in many patients but should certainly not be made a routine. Its greatest usefulness is found in those cases in which a pneumonia threatens, be it as a result of inhalation of flame, fumes, live steam, or smoke, or submersion in water or fuel oil. It is contraindicated in the presence of extensive burns that are being treated with sulfonamides locally, lest excessively high blood levels and consequent renal damage result, and in patients with renal inadequacy. Patients being treated with a sulfonamide ought to have daily determinations of the sulfonamide level in the blood, leukocyte

counts, and hemoglobin estimations, and urine examinations for sulfonamide crystals and evidence of renal damage.

All burns of second degree or more should be covered by a dressing that will effectively keep out infection, unless the treatment itself produces such a barrier, as, for example, the eschar of tannic acid. Once applied, that dressing should be allowed to remain as long as possible—at least 8 days in a third- or fourth-degree burn, and 10 to 14 or more days in second-degree burns, unless the obvious development of infection calls for an earlier change of the dressing. One of the most important safeguards against infection is the avoidance of unnecessary dressings.

All burn patients should receive tetanus prophylaxis. In the case of service personnel who have previously been immunized with tetanus toxoid, this calls for a booster dose of 0.5 cc. of tetanus toxoid. If the patient has not previously been immunized, then he should be given the usual prophylactic dose of tetanus antitoxin and at the same time an immunizing dose of toxoid.

Prophylactic serum against gas gangrene infection is to be administered at the discretion of the medical officer. It has not been our custom to use it in cases of uncomplicated burns sustained on board a naval vessel. The only cases of gas gangrene infection of wounds observed on this ship have been patients who were wounded ashore. Burn patients from the beach are given gas gangrene prophylaxis only if indicated by attendant circumstances, such as concurrent wounds, obvious contamination of severely burned areas, and the like.

The giving of such prophylactic treatment against tetanus and gas gangrene must be recorded by the medical officer who gives it, and that information must accompany the patient, preferably on a tag attached to him as well as in his health record. The commonest—and in most instances the only—criticism which we might utter against those who treated our patients before they came to us was the failure to record tetanus prophylaxis. Unfortunately, one cannot take the patient's word or even the evidence of a swollen site of injection that toxoid was given, since the patient may have received hypodermics for other reasons.

The prevention and treatment of toxemia and other complications vary with the patient; they may involve any of the problems presented by any patient who is going through a severe illness, but certain general measures are applicable to practically all the seriously burned.

From the beginning there must be careful attention to a proper fluid intake. This is a problem in the first day or so, and again after 3 or 4 days in the severe cases, when stupor, delirium, vomiting, burned lips, etc., may be responsible for an inadequate intake. Under

these circumstances, enough parenteral fluid (5-percent dextrose solution, physiological saline solution) in addition to plasma should be given to produce a urinary output of at least a liter a day. But we must not overlook the fact that at times the fluid intake may be excessive. If it were left to the desire of the patient, an intake of 6 or 8 liters would not be uncommon. Granted that the excessive thirst is largely due to a need for fluid because of fluid loss, yet an excessive intake could be dangerous, by causing an excessive diuresis and loss of electrolytes, and a hemodilution with resultant low blood protein level. An intake of over 4 liters is, therefore, rarely justified. Thirst should be counteracted by giving intravenous plasma and other fluids as called for and by allowing the patient to suck ice. It is obviously important that a careful record be kept of the intake and output of fluids.

The finding of a low plasma chloride level, to be looked for particularly in patients who are vomiting, calls for administration of salt by mouth, or parenterally in physiologic solution. But this must not be done too freely. Excessive amounts of salt, especially in the presence of a low blood protein level, will cause fluid retention and more edema. Especially must care be used in salt administration when the patient is also being given eschatin, since eschatin causes chloride retention, with increased blood volume, and so may be an added cause of generalized edema. It is highly desirable that salt therapy be controlled by daily blood chloride determination. If this is not possible, then the daily salt dosage by all routes of administration should be limited to a total of not over 5 to 10 gm.

Patients with cough, increased respiratory rate, cyanosis, and pulmonary signs of infection or circulatory failure require oxygen therapy. This differs in no way from such treatment in other patients. The usual admonitions apply: Don't wait too long to begin giving oxygen; give enough.

Adequate food and vitamin intakes are essential from the onset. Fruit juices are usually welcomed and well tolerated. As soon as the patient is able to eat, he should be given a diet high in protein and carbohydrate, but at first low in fat, as a safeguard against damage to the liver. He should receive several daily doses of a vitamin concentrate.

When the danger of hemoconcentration has passed, daily hemoglobin estimations are nevertheless in order, since a secondary anemia can develop rapidly. It has been our rule to give patients whose hemoglobin had fallen to 70 percent or below a transfusion of 500 cc. of whole blood. If the patient seemed quite ill, a figure of 75 percent called for transfusion. We did not rely on the blood type of the recipient as recorded on his identification tag or health record but in each instance retyped the patient and did a cross agglutination with

the blood of the proposed donor. The wisdom of this procedure was confirmed by the finding that in one patient the blood group differed from the one on record.

In the severely burned, the use of analgesics and sedatives requires increasing caution after the first 24 hours. Opiates tend to have a cumulative effect, especially if renal function is at all impaired. This is also true to some degree of the barbiturates. On several occasions, a stupor proved to be due to the last previously given dose of sedative. It is well to reduce the dose when feasible, mindful of the possibility of inducing a drug addiction, and to shift to more innocuous preparations. Barbiturates, especially in the seriously burned with poor kidney function, at times cause delirium if used too freely. Bromides and chloral hydrate seemed less prone to produce "hang-overs."

We wish to emphasize an important measure in the general care of burn cases; it might be called preservation of vasomotor control. Any patient who remains long in the horizontal position soon loses the nicety of vasomotor action that instantly corrects for changes in position, notably to the erect posture or the dependent position of the lower extremities. This is particularly true with burn patients: Within a week they lose their capacity adequately to adjust for such changes. As a result, not only do the dependent portions—arms as well as legs—quickly show edema, but burn areas bleed freely. The patients on sitting up or standing become dizzy and may faint.

On the other hand, if they are gotten early into these positions, this does not occur. Even in the presence of considerable fever, we have sat these patients up on the third or fourth day, at first on the edge of their bunks, later for a few minutes in a chair, and have helped them stand erect for a few moments. This was done several times a day. As a result, they never lost their vasomotor control to any great degree, and convalescence was decidedly shortened as compared with that of patients who, for one reason or another, had to be kept flat in bed.

It must be emphasized, however, that such change of position was largely passive as far as the patient was concerned. Under no circumstance was he allowed to exert himself. There is ample evidence to show that exertion is dangerous for these patients, resulting in serious or even fatal cardiac failure.

As healing progresses, movement of the burned parts is encouraged, but this must not be done indiscriminately. Thus, in areas of third-degree burns, especially when the burns involve joint regions, mobilization can be overdone, for premature movement of these areas prolongs infection, with overgrowth of granulations and delay in healing. In fact, immobilization of joints permits more rapid preparation of a denuded area for skin grafting.

THE LOCAL TREATMENT OF BURNS

The first question which must be answered is: To what extent shall one carry out debridement of the burn area? The answer differs with each case. Theoretically, the more carefully the burn surface is cleansed and rid of all dead tissue and blisters, the less likely is there to be infection and the more quickly will healing take place. But such a thorough debridement has a very limited application. It should be considered only in case of very limited extent of burns and in a patient without any likelihood of developing shock, let alone with any evidence of shock actually existing. That, we think, virtually rules out a thorough debridement in all really severe and extensive burn cases.

Shock is the greatest threat to life. Nothing should be done, and that includes treatment, that will precipitate or increase shock. Harrison and Blalock (9) have shown that in burned dogs debridement of the burned area materially shortened their survival time. To attempt extensive debridement in the severely burned, even under local anesthesia, is therefore an unjustified hazard.

What, then, is the procedure of choice? The debridement must be modified to conform to the patient's general condition and the attendant circumstances. A severely shocked patient should be treated, dressed, and put at rest as soon as possible. That means the simplest and gentlest cleansing of the burn area with plain soap (not tincture of green soap) and water, cutting away with scissors the larger blisters and detached epidermis—what doesn't hurt is safe—and then the prompt application of the definitive dressing. So well have these patients done with so minimal a debridement that we have tried the same procedure in milder cases and found they did as well as if a thorough debridement had been carried out. A minimal amount of handling probably also makes for a minimal amount of contamination.

Freshly burned patients are often admitted covered with fuel oil. It must be removed, both to determine the degree and extent of the burns beneath, as well as to keep it from interfering with the local action of the sulfathiazole to be used in dressing the burns. After experimenting with various solvents, we have found that *mineral oil*, followed by plain soap and water, is the best and least traumatizing means for removing fuel oil. *Sterilized cotton waste* is the best as well as the cheapest thing to use in this cleansing. It should be kept on hand in large quantities.

Local therapeutic dressings.—At this point the subject becomes decidedly controversial; rivers of ink have flowed in defense of this, that, or the other procedure as the method of choice for treating all kinds of burns. Whereas it is a common medical experience that when numerous treatments are offered for the management of a disease, their individual value is in inverse ratio to their numbers,

that is not true in this instance. One might rather say that "all roads lead to Rome," albeit some roads would seem to be easier to travel, some shorter, and some passable for only certain types of cases.

It is not our intention systematically to discuss all the methods of dressing burns. We wish, however, to point out certain underlying principles which any method of local treatment must embody if it is to be successful. Furthermore, in the light of our experience, we wish to record the observed advantages and shortcomings of certain methods of treatment that have been extolled by their protagonists.

Much confusion and serious error can be avoided if it be kept clearly in mind that the type of local treatment applicable to a burned area depends on whether one is dealing with a sterile lesion or one in which infection has already begun. Since burns seen early are sterile, such cases call for what may be called primary local treatment. Whatever measure is proposed, it must be suitable for the treatment of a sterile wound. Burns that are infected require what may be termed "secondary local treatment." Again, any method of treatment proposed must be suitable for the treatment of an infected wound. When we have encountered therapeutic results that were less good than might reasonably have been expected, they were rarely attributable to the inadequacy of a method for any phase of burn treatment but nearly always to mistakes on the part of a medical officer who selected a wrong method for the case in question.

There are certain underlying principles of primary local treatment that every method must embody, if it is to be successful:

(1). It must exclude air. This has primarily the object of relieving pain.

(2). It must exclude bacteria. That means that the dressing must remain intact in spite of movement and manipulation.

(3). It must in itself possess a bacteriostatic or antiseptic action.

(4). It should exert local pressure to lessen fluid loss (edema, oozing).

These four are "musts," in our opinion.

In addition, the following are desirable attributes of any method of local treatment to be used on board ship and under battle conditions:

(1). It should be easy to apply.

(2). It should be available for mass treatment of many cases by a limited personnel.

(3). It should be economical, and sparing of supplies and materials.

(4). It should be usable in the secondary local treatment of burns when these have become infected. This last is in the interest of conserving valuable space on board ship.

With the foregoing principles in mind, some comments are now offered on various forms of treatment that we have seen used in our patients or strongly advised by others.

The continuous saline bath.—This has been the first method used in a considerable number of our patients—not in a bathtub, to be sure, but in the sea. There is no doubt that it effectively keeps out air and so relieves pain. Some of our severely burned patients were in the water for as long as 10 hours, during which time they were completely comfortable as far as their burns were concerned. In fact, many of them did not realize the extent of their burn until they were removed from the water. In a few of our patients this method was used after they had been transferred to hospitals ashore in preparing an extensive third- or fourth-degree burn area for skin grafting. But as a routine method for burn treatment, it has several serious disadvantages. It is applicable only to a very few cases at a time under special conditions in a hospital. It is not desirable in early and extensive burns because it does not prevent, and may actually increase, the loss of fluid from the burned area. It does not prevent infection.

Wet dressings with saline solution.—This is a modification of the salt bath, and a quite practical one under many circumstances. It is particularly useful for burns of the face, ears, hands, feet and genitalia. Although not in itself a safeguard against infection, it may well be combined with bacteriostatic measures, namely sulfonamides. It permits the use of pressure bandages. Its possible draw-backs are: The frequent attention required to keep the dressings wet, the need for change of dressings daily or every other day and the consequently increased chance for infection, and the consumption of much sterile dressing material.

Triple dye treatment.—This is alleged to have the advantages of producing a soft, pliable eschar that may be used on any part of the body, including the face and hands, is easy to apply, excludes air, is bactericidal, and does not require frequent change. Our experiences with patients so treated have been frankly disappointing. In the first place, this method does not relieve pain nearly as well as does any one of the other types of treatment we have encountered. Time after time we have noted this in patients side by side with others burned to the same extent and in the same regions but treated by another method. It is extremely difficult to tell either how extensively the patient has been burned, since normal and burned skin are indiscriminately dyed, or how ill the patient is as judged by pallor,

cyanosis, sweating, and general appearance. It is harder to find veins for the parenteral administration of fluids. The havoc wreaked on bed linen is appalling.

Paraffin-wax spray.—This method has recently been revived and given much publicity in certain quarters. Its advantages are claimed to be ease of application, soft, pliable texture that makes it suitable for face burns as well as elsewhere, and no need for any type of bandage or dressing over the wax. To counteract infection through cracks in the film over the burn, additional layers are sprayed on at intervals of a day or less. To make for sterility, antiseptics have been combined with the paraffin, and some have blown a sulfonamide powder on top of the wax film.

Again our experience with severely burned patients so treated has been almost uniformly unfavorable. The coating, in spite of a certain pliability, does crack under the action of very little force. To add successive layers of wax by repeated spraying only increases the tendency to crack, since the thicker the layer, the cooler its outer surface and consequently the more brittle. Infection, therefore, does take place easily and early, especially in deep burns. Some of the worst infections that we have encountered have been under thick, week-old, very foul-smelling crusts of this material. The addition of sulfonamides and antiseptics, especially the spraying of sulfathiazole powder on top of the wax film, made no difference; nor, indeed, did we see how it could under the primitive attendant circumstances of a tropical island battleground. The only burns that did well with this treatment were those that were largely first degree, with at most only small areas of second-degree involvement.

Tannic acid.—This well-known method has a number of obvious advantages. These include ease of application, thorough exclusion of air, diminished absorption of toxic substances from the burned area by fixing necrotic tissue, good protection against infection from without. Its firm and unyielding texture accounts for a pressure effect, especially in burns encircling an extremity, and so helps prevent edema and loss of fluid. It obviates the need for frequent painful dressings during the early days of the patient's illness. It simplifies the nursing care and is economical of supplies. For an uninfected eschar can and should be left in place until it can be removed easily and painlessly, a matter of 2 or 3 weeks.

But there are also decided limitations and some disadvantages in its use. Because of the rigid texture of a tannic acid eschar, it should never be used on the face, ears, hands, feet, axillae, perineum, and genitalia. Yet burns of the face, ears, and hands are extremely common. Some medical facilities on ships and outlying stations have provided themselves adequately only with tannic acid preparations and so have nothing else to use on face and hands after the first few

patients have been treated. At times hospital corpsmen have made no distinction in the part to be treated. We have, therefore, seen many patients with heavily tanned eschars on face and hands, each of which became infected, if it was not already so on admission here. Such an infected eschar must often literally be whittled away from the burned area with the greatest care, lest further damage be done to living tissue. For infection under the eschar does rapid and serious damage, especially to cartilage, where that tissue is close to the skin as in the ears and nose. The discomfort inflicted upon a patient by the piecemeal removal of a tannic acid eschar from ears, nose, and fingers may well be imagined. We cannot be too emphatic in denouncing the use of tannic acid on face, ears, and hands.

Tannic acid undoubtedly can and does kill thin layers of epithelium. In cases where islands of epithelium have just managed to survive the burn, the use of tannic acid may be responsible for converting a second-degree burn into a third-degree one.

The occurrence of infection under the eschar is a complication which not only terminates the usefulness of the tan but converts it into a menace. Infection is a definite factor in the destruction of surviving epithelium. In using tannic acid, therefore, one must bear in mind the circumstances under which infection is likely to occur, one must take steps to avoid infection, and be alert to recognize and treat it when it develops. Tannic acid should not be used over joints such as the elbow, knee, or ankle unless that joint is also immobilized by a splint. Otherwise, cracks will develop in the eschar and admit bacteria. The possibility of infection under the tan also varies with the depth of the burn: It rarely occurs on a second-degree burn and not often over small areas of third-degree involvement. It is frequent over extensive third-degree burns, and it is sure to occur within a week or less over fourth-degree burns. When infection does develop under a part of the eschar, then there is a much greater chance of infection spreading to other burned areas by contact infection, or to distant sites by blood stream metastasis. Thus in one of our patients a subscapular abscess followed severe burns of the face and arms. Tannic acid should, therefore, not be used over extensive fourth-degree burns. Infection under the eschar is more likely to happen if an extensively burned area is also subjected to pressure. Thus, if there are such burns on both the front and the back of the trunk, that aspect on which the patient lies tends to become edematous and macerated, the eschar cracks, and infection promptly occurs. It is therefore unwise to use tannic acid under such circumstances unless it is possible frequently to shift the patient's weight off the burned area.

A not uncommon cause for the development of infection under the eschar is that the tan was applied too late, when infection had already begun. Tannic acid should not be used in patients whose burns are

over 12 hours old, unless some particular circumstance has helped to preserve sterility, as, for example, immersion in uncontaminated sea water.

It is not easy to discover infection under a heavy eschar. Palpation is helpful by disclosing places where the eschar is lifted clear by pus beneath. Suspicious areas must be investigated through small openings, but care must be taken that such openings do not themselves become portals of entry for infection. The presence of fever and leukocytosis may be the first indication of infection.

When infection is found to have developed under a tannic acid eschar, the eschar must be cut away, bit by bit, wherever it is found to have been separated from the surface of the burn by secretions, or wherever it comes off easily over an area that has already healed. Only such portions are allowed to remain which are tightly adherent and the attempt to remove which results in bleeding. The local treatment of the infected area is then the same as that of any infected wound and will be discussed later.

There is the danger of liver damage from absorption of tannic acid from the burn area in patients with extensive burns. The evidence that this can happen has been cited in an earlier paragraph on the absorption of toxic substances from burns. Extensive central lobular necrosis of the liver was present in a patient who died on board and who had been extensively covered with tannic acid before being admitted to this ship. Absorption of tannic acid is more likely to occur when slow methods of tanning are used, such as tannic acid jelly or tannic acid solution without silver nitrate. The fact that central lobular necrosis has been found at autopsy in a few cases not treated with tannic acid simply proves that there are other causes of that condition in addition to tannic acid. It does not greatly detract from the probable role that tannic acid plays in causing such liver damage, and it certainly does not, as some have claimed, rule out tannic acid as a cause of liver damage.

In the local treatment of all of our patients we have used sulfathiazole, especially in its microcrystalline form, either as an ointment or as a powder, the latter supplemented, if desired, by wet saline dressings. When we were the first to see the patient, the primary local treatment was with sulfathiazole and the use of pressure bandaging. When patients who had primarily been treated elsewhere by other methods developed infection, we used sulfathiazole, usually in the form of the microcrystalline powder applied by a blower, and supplemented by wet dressings, as the method of secondary local treatment, both for infection and in preparation of the burn area for skin grafting. Since this is, to the best of our knowledge, the first large series so treated, and since the results compare favorably with those by other methods, we shall describe our procedure somewhat in detail.

We have used sulfathiazole in preference to sulfanilamide for two chief reasons. Sulfathiazole is much less soluble and therefore both less rapidly absorbed to produce possible toxic effects as well as more likely to remain at the site of the burn to continue its bacteriostatic action. Thus, sulfanilamide would be completely absorbed in less than 24 hours, whereas sulfathiazole remains for 3 or 4 days or longer. The second reason is that sulfathiazole is probably more effective against the types of bacteria usually encountered in burns (staphylococci, streptococci).

Sulfathiazole ointment: We have used an ointment, preferably prepared with the microcrystalline form of sulfathiazole, as the usual primary local treatment of burns. The ointment base should be water-soluble, in order to insure the best local bacteriostatic action of the drug. To those who argue for oily dressings or ointments, it is also pointed out that oily dressings mask the appearance of infection by interfering with the drainage of pus; that a water-soluble preparation deteriorates less rapidly in hot climates, is easier to handle, and can be allowed to remain on a dressing for a longer time without being changed. It must be remembered, too, that oily preparations must never be used on burns produced by phosphorus.

We have used by preference the following formula for a vanishing cream, taken from Remington's Practice of Pharmacy (14):

Stearic acid.....	1 ounce.
Glycerin.....	1 ounce.
Distilled water.....	4 ounces 6 drams.
Sodium borate.....	8 grains.
Potassium carbonate.....	16 grains.
Perfume, as desired.....	45 minims.

Melt the stearic acid on a water bath and heat to 85° C. Dissolve the alkali in the water, add the glycerin, warm the solution to 85° C., and gradually pour the warmed solution into the stearic acid, stirring briskly. Continue to stir actively and at the same temperature to assure complete saponification and absence of free alkali. Then remove the heat and continue to stir until cold, at the same time incorporating the perfume. The cream should afterward be beaten for several hours, preferably by mechanical means.

Because of the temporary inability to get stearic acid, we have used also a mucilage of tragacanth with 0.25 percent phenol, according to the following formula and method of preparation:

Tragacanth.....	60 grams.
Glycerin.....	180 grams.
Phenol (88 percent U. S. P.).....	2.5 cubic centimeters.
Distilled water to make.....	1,000 grams.

Mix the glycerin with 750 cc. of distilled water in a tared vessel, heat the mixture to boiling, discontinue the heat, add the tragacanth, macerate the mixture during 24 hours, stirring occasionally. Then add the phenol and enough distilled water to make the mixture weigh 1,000 grams. Stir actively until it is of uniform consistency, then strain through muslin.

In the absence of materials to make up either of these formulae, any of the commonly used *brushless shaving cream* preparations can serve as the water-soluble ointment base.

The amount of sulfathiazole in the ointment is preferably 3 percent. At first we used 5 percent; but, as previously noted, we found in one patient with burns involving at least 75 percent of his skin area that the application of a 5-percent ointment gave rise in 40 hours to a blood level of 7.5 mg. of sulfathiazole per 100 cc., and to sulfathiazole crystals in the urine. We have observed no decrease in local effectiveness with the weaker ointment.

The ointment is applied by being spread thinly on sterile gauze dressings with the help of sterile wooden tongue blades. The most generally useful size of dressing is 4 by 8 inches, but a few larger ones may be helpful on the trunk. Several thicknesses should be used to allow for absorption. In the case of the extremities, the dressings may first be held in place by a few rapid turns of a gauze bandage. In case of involvement of the hands or feet, dressings should separate the fingers or toes. The thumb should be placed in apposition to the fingers, and thumb and fingers should be slightly flexed. A wad of sterile cotton waste or gauze placed in the palm will facilitate holding this position. If the fingertips are not involved, it is well to leave them uncovered. A large pad of sterile cotton waste in the axilla will hold the dressing against the skin as well as exert some helpful pressure. When the dressings are in place, the pressure bandage is applied. The cotton-webbing elastic bandage on the Supply Table is ideal for the purpose, but one can use a dampened gauze bandage. The bandage should, of course, begin at the end of the extremity and be applied snugly as high as the dressings go and a bit beyond. The pressure bandage should be put on by a medical officer, not a nurse or hospital corpsman, in order to guard against too much or too little pressure, and he should watch for evidences of excessive pressure. The properly applied pressure bandage will sufficiently immobilize a joint to make a splint unnecessary. Elastic bandages should be fastened with safety pins, not adhesive. Upon removal, they should be washed and sterilized for further use. Over the trunk the application of a pressure bandage is not feasible, but some pressure can be exerted by a snugly applied scultetus binder.

Burns of the face, ears, and genitalia can be treated in the same way with sulfathiazole ointment, except that these regions must not be bandaged. A simple gauze mask for the face and gauze dressings loosely applied about the ears will suffice. In these cases, however, as well as in burns elsewhere that are obviously deep, we are more likely to use sulfathiazole microcrystalline powder, blown on the burned area with an atomizer, and then covered with wet saline dressings. These should be removed as needed, fresh powder and fresh

dressings applied, until healing has taken place, or until the surface is ready for skin grafting. This will be discussed more fully later.

Primary dressings with sulfathiazole ointment or powder and pressure bandages should be left in place as long as possible until healing has taken place or until the evidences of an established infection call for a change of dressing. In the case of first- and second-degree burns, complete healing will have taken place within 10 to 14 days. At the end of that time, and not before, should the dressings be removed. No further treatment is then required. In cases of extensive third- or fourth-degree burns, complete healing will not take place. In some of them, probably the majority, some infection will develop which must be treated. In all of them a cure cannot be effected until skin grafting is resorted to. In these cases the primary dressing should not be removed until 8 to 14 days have elapsed, unless evidence of infection appears sooner. This may be recognized in several ways: The dressing becomes obviously pus-soaked, or its odor becomes characteristically foul. The burn area becomes painful. The patient shows the constitutional reactions to infection—fever, leukocytosis. But one must not mistake a serum-soaked dressing for an infected one. When serum begins to come to the surface of the dressing, the dressing should promptly be reinforced with additional layers of sterile gauze.

The primary local treatment with sulfathiazole as just described has at least three outstanding advantages: It can be applied to any part of the body. It can be applied to any type of burn. This is particularly true of patients who have suffered wounds in addition to burns. Such combinations of wounds and burns are frequent in naval casualties, and not infrequently the wound involves the burn area. Under these circumstances practically every other type of local treatment except that with sulfathiazole is contraindicated. It is relatively painless. Yet another advantage is that the sulfathiazole, especially in microcrystalline powder form with wet saline dressings, is also applicable to all stages of the secondary treatment of deep burns that are infected and to those requiring grafting.

These disadvantages of the sulfathiazole method may be cited: It cannot be applied as quickly for a primary dressing as can some of the other methods, notably those in which the dressing is simply "sprayed" on. It also requires more dressing materials—gauze, bandages, etc.—than do these methods. It might be stated as a further disadvantage that patients with extensive burns dressed with sulfathiazole require the same safeguards as do all patients receiving sulfonamides internally—urinalysis daily, and leukocyte, hemoglobin, and blood sulfonamide estimations at least every other day, and under some circumstances daily. However, except for the blood chemical study, which may be dispensed with in the emergency (only in the most

extensive burn cases is there any danger of absorption of toxic amounts of sulfathiazole), none of the above disadvantages is an absolute contraindication to the use of the method under battle conditions on combat ships or in advance dressing stations ashore, provided that the medical activity in question has prepared for the contingency. Moreover, by the time the various examinations of blood and urine (hemoglobin estimation excepted) are called for, the military action is usually over and the patients may even have been evacuated to better-equipped facilities.

(To be concluded)



RELIEF FOR JOCK ITCH AND ATHLETE'S FOOT

Two common sources of acute discomfort to servicemen in hot weather, at work, in the barracks, or on the march, are "jock itch" or *tinea cruris*, and "athlete's foot", or *dermatophytosis* of the feet.

Heat, moisture, and trauma of friction against clothing or opposing skin surfaces predispose to and aggravate these conditions. I have tried the various powders, paints, and pastes commonly found on the shelf in sickbays, with the usual indifferent results, and after some experimentation, compounded a dusting powder which has given such uniformly good results that it is considered worthy of further trial. I would not imply that this formula represents any radical departure from existing proprietary dusting powders or that the ingredients are unique, but I have been amply convinced of the effectiveness of the combination, the prompt relief of burning and itching, the rapidity with which sodden tissues become clean and dry, and the moist inflammatory lesions clear up.

The formula:

Menthol, drams i.

Salicylic acid, drams iv.

Tannic acid, ounces viii.

Boric acid.

Talc, aa qs. ad pounds ii.

It has been found convenient to dispense the powder in regulation Navy Medical Department drug envelopes, a half ounce at a time, with a small square of folded gauze included for a powder puff.

Men are instructed to dust this on liberally morning and night after bathing.

Excellent results have attended its use for hyperhydrosis and tired burning feet. In the case of "athlete's foot" with moist and macerated lesions between the toes, an inch-wide ribbon of folded (4-ply) gauze saturated with the powder may be woven between the toes to keep the medication in place and allow some dissipation of heat and moisture.—Bruning, R. H., Lieutenant (MC) U. S. N. R.

THE TREATMENT OF NAVAL PERSONNEL WITH PEPTIC ULCER¹

WALTMAN WALTERS

Captain (MC) U. S. N. R.

and

HUGH R. BUTT

Lieutenant (MC) U. S. N. R.

In this preliminary report we wish to present a résumé of the methods of treating patients with gastroduodenal ulcer admitted to 13 United States naval hospitals, to discuss the problems associated with such therapy, and to present a plan evaluating the effectiveness of medical and surgical therapy.

Methods of treatment.—In most instances, symptoms of ulcer without complications among new recruits were present prior to enlistment. Since most of these men are young, few in this group should be considered as candidates for surgical procedures, and hence these men are probably best discharged from the service. It is difficult to carry out a dietary program aboard ships where there is little opportunity to give adequate physiological rest to the gastrointestinal tract due to the ship's motion and the routine Navy rations. On the other hand, officers and enlisted men whose ulcers have developed in line of duty are entitled to medical or surgical treatment either as members of the Navy or in Veterans' Administration hospitals upon discharge.

The initial problem is: Should these patients be continued in the service on active or limited duty, or should they be retired or invalided out because of their ulcers? It is our opinion that each case should be considered as an individual problem, basing one's judgment, among other things, on the duration and severity of the ulcer symptoms, and hence whether best treated medically or surgically, and the importance of the man to the Navy.

Wade, in writing on dyspepsia in the Royal Navy, states that 50 percent of patients with peptic ulcer were invalided from the service.

In the collected series of 1,352 patients, reported from 13 naval hospitals, with gastric and duodenal ulcer (1,219 duodenal, 112 gastric, and 21 gastroduodenal), 1,249 were treated medically (92 percent) and 537 (43 percent) were discharged or surveyed from the service.

Mild symptoms and no complications.—Although the principles of the medical treatment of ulcer are the same in the Navy as in civil prac-

¹ Abstract of paper read at the meeting of the American Surgical Association, Cincinnati, Ohio, May 13 and 14, 1943.

tice, the irregular hours, inadequate types of food, seasickness, fatigue, nervous strain, and apprehension are a great hindrance to medical management; medical treatment, therefore, is advised only when symptoms are mild and of short duration.

Aboard large ships, because of special messes and privileges, officers who have ulcers have a better opportunity for adequate medical management than enlisted men do. For this reason every opportunity is given them to return to duty if their ulcer is responsive to the usual treatment; if it is not responsive, surgical intervention is advised. We have observed 35 patients with proved gastric or duodenal ulcer at a naval hospital in this country during the past 6 months. Twenty-two were treated medically; 16 (73 percent) of these were returned to duty and 6 discharged. Of the 6 discharged, 3 were advised to have operations because of complications, but refused; the other 3 had medical conditions other than ulcer requiring discharge.

Our patients with ulcer have cooperated well, and almost all have been anxious to return to duty. Those who responded to medical treatment did so in the manner usually expected in civilian practice. This is in contrast to the experience of Flood, who observed that in the Army a large number of patients continued to complain of discomfort even after long periods of adequate treatment. Many of our patients have experienced dangerous and strenuous action and date their gastrointestinal symptoms from that period of mental and physical stress and strain. A large percentage of these patients quickly become free of symptoms simply with rest and proper food at regular intervals. Those who quickly become symptom-free and evidence desire to return to duty are returned without restrictions; others less sure of themselves who experience occasional dyspepsia are returned to limited duty ashore; those who have serious complications are advised to have an operation. Time and experience will determine the success of this policy, but in view of the increasing need of trained manpower, this program seems justified.

In the collected series from the United States naval hospitals the reason generally listed for discharging patients treated surgically from the service was their inability to tolerate a general diet. Of those treated medically and later discharged, the reasons were listed as follows:

1. Disease existed prior to enlistment (EPTE) in a young recruit.
2. History of many recurrences.
3. Symptoms not relieved and surgical intervention refused.
4. Repeated hemorrhages.
5. Accompanying severe functional disturbances.

Surgical treatment.—We believe, however, that a history of multiple recurrences is a direct indication for surgical treatment, as is a history of repeated hemorrhages, and that most of such cases, if operated upon.

could be continued on active duty. The reasons for choosing surgical treatment for naval patients with peptic ulcer are essentially the same as those for civilian patients. In our series of 13 cases surgical treatment was advised for repeated hemorrhage, pyloric obstruction, perforation, or frequent recurrence with progressive symptoms in spite of medical treatment. Partial gastrectomy with a posterior Polya type of anastomosis was performed in 85 percent of the cases; in one case gastro-enterostomy was done because technical difficulties prevented gastric resection; in one case of perforated duodenal ulcer simple closure was the procedure of choice.

The importance of making an early decision as to the type of treatment to be employed and the disposition of the patient cannot be over-emphasized. If surgical treatment is indicated, the earlier the operation is performed and the patient returned to duty the better. Since all these patients are hospitalized, there is a tendency to delay this decision until the patient has become so accustomed to hospitalization that he is reluctant to return to combat duty regardless of the result of treatment. In our group of 13 cases in which operation was performed only 2 patients were invalided from the service. One was an officer who had spent a total of 14 months in various hospitals undergoing several courses of medical treatment before operation was advised. Although the surgical result was physiologically and clinically excellent, the long period away from duty and the mental attitude developed by prolonged hospitalization and limitation of activities, both physical and dietary, were sufficient to produce a functional failure in 2 months after his return to active duty. The second patient had a good result from operation, but was discharged because of an incapacitating war injury.

Further studies of the ulcer problem.—It is fairly obvious that further study of treatment of ulcer among men in the Navy is indicated. At present we are not concerned with young recruits who have ulcers that existed prior to enlistment. Such patients are discharged from the service because medical treatment cannot be carried on with any degree of satisfaction, and yet they do not have sufficient trouble so that surgical procedures can be advised. When the ulcer is incurred during the period of active service, however, it is important to treat the patient in such a way that he may return to duty if possible. This is particularly important if the patient is an officer or a specialist who has become a real asset to the service.

Several problems must be solved in these cases: The first is whether repeated medical treatment is advisable. Of 537 patients in the collected series medically treated and discharged from service because of ulcer, 25 percent had repeated periods of hospital treatment for their ulcer. The chances of those in this group of responding to

medical treatment so that they become useful to the service is exceedingly doubtful. It seems possible that surgical treatment should be employed more extensively in this group of cases.

The second problem is the need of follow-up studies to determine the results of surgical treatment in the naval service. In our series, 37 percent of the patients were treated surgically, 85 percent of whom were returned to duty. In the collected series only 8 percent (106 cases) were treated surgically, of whom 71 percent were returned to duty. These results should be compared with those of conservative medical treatment.

To evaluate the final results of surgical treatment will require a follow-up study to determine the time spent on the sick list, ability to stand active and limited duty, and a comparison of both medically treated and surgically treated patients to determine whether the radical treatment by gastric resection is warranted.

Certainly, from the results shown herein, there is, we believe, justification for radical surgical treatment of naval patients who have chronic, recurring, gastric, or duodenal ulcers which develop during service. Officers and enlisted specialists with such ulcers whose knowledge, experience, and ability in naval activities make them particularly valuable to the Navy, and the 25 percent of medically treated patients who are discharged from the service because of chronic recurring ulcers, are the particular patients, we believe, who should be given the benefits of surgical treatment with the hope and expectation that their valuable services can be retained. However, until a much larger series of naval patients is operated upon, and observed subsequently as regards their reaction to naval duty, the advisability of surgical treatment in order to return such ulcer patients to duty cannot be determined definitely.



READMINISTRATION OF SULFADIAZINE

Febrile reactions to a second administration of sulfadiazine are less frequent and less severe than those reported for sulfathiazole.

Febrile reactions to the readministration of sulfadiazine are frequently accompanied by delirium, chill, and a maculopapular rash.

Sulfadiazine, as well as the other commonly used sulfonamides, should be given only in those cases which with certainty justify its febrile response per se as harmful.—Talbot, T. R., Jr., and Adcock, J. D.: Febrile reactions resulting from the readministration of sulfadiazine. *Am. J. M. Sc.* 205 : 841-846, June 1943.

SUBCUTANEOUS JUXTA-ARTICULAR NODULES ¹

A STUDY OF THEIR CLINICAL AND HISTOLOGIC CHARACTERISTICS

CHARLES L. McCARTHY
Commander (MC) U. S. N. R.

The return to active duty of so many retired officers and men of the Navy has again called our attention to the rather frequent occurrence of cutaneous and subcutaneous fibroid nodules occurring particularly in the regions adjacent to the large joints (elbows and knees). Although dermatologists have been interested in them since they were studied by Jeanselme (1) in 1901 with reference to their occurrence in syphilis and yaws, textbooks on dermatology devote only a line or two to mention them. No effort is made to describe their clinical or histologic appearance or to differentiate them from similar nodules occurring in other diseases. Internists have long associated them with rheumatic fever or rheumatoid arthritis, but there still exists a great deal of uncertainty as to their occurrence in many other diseases and their exact method of evolution as well as their etiology.

In view of the large number of cases of filariasis returning from the South Pacific areas and the difficulty attending the demonstration of the parasite in the blood stream or in lymph glands, it is interesting to note that filariae were aspirated from juxta-articular nodules in this disease by the Harvard Expedition (2) working in Liberia and in the Belgian Congo in 1930. This may be the only means of establishing the diagnosis in chronic cases. Such cases are extremely important, since, if undetected, they may become sources of contamination for our own population during periods of recrudescence.

As early as 1884, Fowler (3), after studying these nodules in syphilitic patients, showed conclusively that they might occur in diseases other than rheumatic fever or rheumatoid arthritis. Lutz (4) in 1891 described such nodules in leprosy. Ketron (5) in 1913 reported them in acrodermatitis chronica atrophicans and, after careful histological studies, classified them as fibroids. In 1923 Gray (6) found numerous subcutaneous fibroid nodules located in the usual juxta-articular regions in a young woman suffering with diffuse scleroderma. Coates and Coombes (7) found them in Still's disease and in subacute bacterial endocarditis.

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No doubt exists today that they frequently occur in the chronic arthritides. Whether they are seen more frequently in syphilis or in jaws or in the arthritides apparently depends upon the investigator. Dawson and Boots (8), investigating this subject as intertists, found them only in arthritics. Hopkins (9), in a very excellent article from the syphilitic clinic at Johns Hopkins Hospital, reported on 14 patients, 12 of which had syphilis and 2 of which had chronic arthritis. Comparative studies of the subcutaneous nodule of rheumatoid arthritis and of similar nodules occurring in rheumatic fever have been made by McEwen (10), Hawthorne (11), Dawson (12), and many others. These studies have shown that the nodules are very similar, if not identical, in many of their histologic and clinical characteristics.

Bennett, Zeller, and Bauer (13), in an exhaustive pathologic study of a large number of nodules taken from many patients with rheumatoid arthritis and rheumatic fever, decided their studies did not permit conclusions concerning the nature of the agent or agents causing these nodules. They did, however, make a valuable contribution in that they were able to differentiate by microscopic study alone one type of rheumatic nodule from the other. Hopkins and other investigators concluded from their studies that they could not differentiate nodules occurring in syphilis from those found in arthritides.

Collins (14), after describing distinguishing features of subcutaneous fibroids, concluded that there was insufficient evidence to justify postulating either a close pathologic relationship or a common etiologic agent.

CLINICAL PICTURE

The description of juxta-articular nodules is necessarily brief, since they present an almost uniform picture and pursue a constant course. Juxta-articular nodules are usually slow-growing, painless, elevated, well-defined, and often lobulated tumors which are either firm or hard to the touch. They may vary in size from that of a pea to a robin's egg or even larger. They are freely movable in the cutis or subcutis and are not attached to the overlying skin, which shows no sign of inflammation. Ormsby and Montgomery (15) reported three cases occurring in old syphilitics in which nodules occurred on the palms and were attached to the tendons. This unusual attachment to the tendons can be explained by the anatomical make-up of the hand, where there is so little subcutaneous space that any growth becomes quickly attached to adjacent structures. They pursue an indolent course and rarely tend to soften or ulcerate. In fact, they may disappear spontaneously as the result of reparation and absorption. Nodules occurring in filariasis and nocardiosis differ somewhat from

those described above, in that they are stony-hard and occasionally ulcerate. The nodules found in syphilis and yaws seem to be the only ones that respond readily to treatment; and this is not surprising, as these nodules are atypical gummata due to a causative agent for which we are applying a specific remedy. The larger nodules seen in the arthritides, as a rule, remain unchanged over a period of years after they have reached a maximum growth. The smaller nodules may disappear spontaneously.

HISTOPATHOLOGY

Histologic studies reported by many observers have resulted in a variety of opinions. This is to be expected if we are to accept the belief that the nodules are due to many different causes. Hopkins stated that sections from his cases occurring in known syphilitics presented features that have been pointed out by individual investigators of syphilitic and of rheumatic nodules, as characteristic, respectively, of these two diseases. Bennett and his co-workers reported a fairly constant histologic picture for the nodules in chronic infectious arthritis and for those seen in rheumatic fever. They found that whether single or multiple in character, the nodules in each disease were alike in that each lesion has three well-defined merging zonal areas. These areas have previously been designated as (*a*) the central zone, or zone of necrosis; (*b*) the intermediate zone, comprised of proliferating cellular tissue, the cells of which may or may not be arranged in the so-called palisading pattern; and (*c*) the peripheral zone, consisting of the inflamed tissues in which the nodule develops. While it is generally conceded that the central zone in both types of nodules show either fibrinoid changes or necrosis and degeneration, or both, the predominance of one type of change over the other depends upon the state of evolution of the nodules.

These observers felt that necrosis and degeneration were predominant in rheumatoid arthritis, while the fibrinoid changes characterized the rheumatic-fever nodule. The fibrinoid changes consisted of widespread separation and swelling of the collagenous bundles which have a special affinity for eosin dye. There is a marked exudation of plasma and fibrin into and between the swollen bundles. Mononuclear cells, small lymphocytes, polymorphonuclears, plasma cells, and eosinophils composed the infiltrate in this zone. On the other hand, the central zone of the rheumatoid arthritis nodule shows large areas of marked necrosis, with complete or almost complete destruction of preexisting collagenous tissue. These areas consist of masses of granular debris. Remnants of preexisting vessels or collagenous tissue could be seen on the edges of the necrotic zone. The finding of true necrosis should distinguish these nodules from the lesions of

granuloma annulare, where only a pseudo or coagulation necrosis is found. In long-standing juxta-articular nodules, calcification of the necrotic zone may take place, and eventually cholesterol may be found. The necrosis can have progressed to liquefaction and cavity formation.

In the intermediate or proliferative zone of the rheumatoid nodule, definite palisading of the cells bordering upon the necrotic zone was a prominent feature. The palisading cells are fibroblasts in the process of active proliferation, and they form a limiting wall which tends to repair the damage when the inflammatory process ceases. The intermediate zone in the nodules of rheumatic fever, as is to be expected, shows only edematous, inflamed connective tissue beset by an acute and subacute type of inflammatory infiltrate. Bennett et al., described numerous large oval or round cells, often multinucleated, containing vesicular nuclei with prominent nucleoli surrounded by an abundance of nongranular cytoplasm. They occurred frequently in areas of the most marked fibrinoid degeneration and were thought to resemble the predominant cells of myocardial Aschoff nodules. They were also seen in fibroblasts and in the endothelial cells of the capillaries. These authors found little if any palisading in the nodules of rheumatic fever.

They interpret the changes observed in the nodule of rheumatic fever as resulting from injury to small blood vessels, with subsequent exudation of blood cells and plasma into the surrounding connective tissue. In the nodule of rheumatoid arthritis, proliferation and degeneration of the connective tissue predominate, while exudation occurs only to a slight degree.

From these studies they believe that they can distinguish the nodule of rheumatic fever from the nodule occurring in rheumatoid arthritis, but unfortunately they had no opportunity to compare these two histologic pictures with those seen in syphilis, yaws, and other diseases that produce similar juxta-articular nodules.

Crouzon and Bertrand (16) noted a great similarity between the histologic appearances of rheumatic and syphilitic nodules. This agrees with the findings of Hopkins mentioned above. He studied nodules from four patients with syphilis and two with rheumatoid arthritis. The Warthin-Starry method failed to reveal spirochetes, and elastic tissue stains showed no elastic tissue except in amounts normally seen in the walls of the blood vessels. He found that the nodes were made up of whorls of fibrous tissue infiltrated with epithelioid, plasma, small lymphocytic and a few giant cells. Areas of central vacuolization and true necrosis were commonly seen. He concluded that the picture could not be considered entirely characteristic of syphilis or of any other disease.

The appearance of the nodules found in nocardiosis is described

under differential diagnosis. The nodules seen in *acrodermatitis chronica atrophicans* show only fibroid changes without necrosis or any marked inflammatory infiltration. Occasionally, nodules occurring in any of the various diseases already mentioned may undergo a xanthomatous degeneration, and they may be erroneously reported as examples of true xanthomata.

DIFFERENTIAL DIAGNOSIS

Juxta-articular nodules are characterized particularly by their curious symmetry, their indolence, and their painlessness. The history of an old syphilitic infection, the presence of demonstrable syphilis, and especially the fact that these nodules disappear under antiluetic treatment will serve to establish the diagnosis in a large number of cases.

In arthritides, a careful clinical history and the results of the histologic examination as given by Bennett and his coworkers will separate out a large group of cases. It is to be remembered that a differentiation between these two large groups may be made with some degree of certainty clinically by the fact that in syphilis the nodules are almost entirely confined to the juxta-articular areas, while in the arthritides they usually have a wider dissemination. Again the nodules found in syphilis are usually firmer, as would be expected, since they are simply an unusual fibroid type of gumma. Jessner (17) has secured a take in rabbits by inoculating them with material from a syphilitic juxta-articular nodule.

Since tropical diseases will occupy us more and more as the war continues in all parts of the world, we should be familiar also with the occurrence of these nodules in the nocardial diseases. These nodules lie subcutaneously, are very hard and fibrous, and are about the size of an English walnut. They generally occur over the large joints, such as the elbow, knee, hand, etc. They are indolent, and persist indefinitely, cause no pain, do not influence the general health, and ulcerate only as a very great exception. The causative organism is the *Nocardia carougeaui*, which is found most often in the fibronecrotic center of these nodules, loose in the tissue or in large giant cells. This is the same parasite that causes Madura foot. As previously mentioned, the type of nodule that occurs in filariasis may be identified by the fact that microfilariae can be aspirated from them.

Microscopic differentiation between nodules occurring in syphilis and in the arthritides is not always so simple, since a number of observers have found that early juxta-articular lesions of syphilis and late organized rheumatic nodules may present features characteristic of each other. The finding of Aschoff bodies in these nodules helps to identify them as being of rheumatic origin.

To complicate the picture, a number of observers have reported that juxta-articular nodules seen in *acrodermatitis chronica atrophicans*

show a histologic make-up similar to that seen in syphilitic nodules.

In résumé it may be said that efforts to establish histopathologic or other criteria by which one may identify any individual nodule have been futile except in the case of nodules arising in nocardiosis, where the parasite may be demonstrated by proper staining methods and in filariasis, where the parasite can often be aspirated. In the large majority of cases, however, we should arrive at a proper diagnosis by combining careful clinical and microscopical studies.

At times these nodules may closely simulate the nodules seen occasionally in many other conditions, such as leprosy, sarcoidosis, xanthomatosis, lipomatosis, and neurofibromatosis. Solitary sarcoma, myoma, gout, and sclerosing hemangioma may be mistaken for juxta-articular nodules.

Gouty nodules may bear a close histologic resemblance to juxta-articular nodules of different origins, but the finding of an abundance of urate crystals in the necrotic area will differentiate them. Calcification is found in all types of nodules in long-standing cases and is no help in differential diagnosis.

Histologic examination will readily identify all these specific diseases just mentioned. An exception to this statement has been furnished by Jessner who found that many of the true juxta-articular nodules may undergo pseudoxanthomatous or foamy degeneration and they may be mistaken for xanthomata.

CONCLUSIONS

1. Attention is drawn again to the difficulty in diagnosing subcutaneous juxta-articular nodules, even after histologic studies and animal inoculations.

2. Such nodules may make us aware of the possibility of filariasis or nocardiosis in individuals returning from known infested areas.

3. Although commonly associated with syphilis, yaws, and the arthritides, they may exceptionally occur in a variety of other diseases or they may closely simulate the clinical appearance of nodules seen in xanthomatosis, neurofibromatosis, leprosy, sarcomatosis, lipomatosis, and sclerosing hemangiomata.

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SHOCK DUE TO BURNS

There is a principle in liver which possesses the activity of combating shock due to burns.

This antishock factor present in some commercial liver extracts is not identical with the antianemia principle.

It appears that the liver principle effective against burn shock is not readily destroyed by heat or aeration and is precipitated from aqueous solution by acetone and ethanol.

Nine-tenths percent solution of sodium chloride, when administered in amounts equivalent to 5 or 10 percent of the body weight, is definitely effective against burn shock when given either after or 30 minutes prior to trauma.

Pretreatment with liver extract plus large amounts of 0.9 percent solution of sodium chloride is significantly more effective than salt solution alone.

The liver factor described and large volumes of salt solution are the only agents which, in our hands, have been found to be effective in burn shock, adrenocortical hormones, thiamine hydrochloride and other vitamins being without significant action. The renal pressor system likewise does not prolong the survival time of animals subjected to burn shock.—Prinzmetal, M.; Hechter, O.; Margoles, C.; and Feigen, G.: A principle from liver effective against shock due to burns; preliminary report. *J. A. M. A.* 122: 720-723, July 10, 1943.

ADENOCARCINOMA OF THE TESTIS¹

REPORT OF CASE

JULIUS L. WATERMAN

Captain (MC) U. S. N. R.

and

OSBORNE A. BRINES

Commander (MC) U. S. N. R.

The subject of testicular neoplasms has been rendered difficult to understand by the inconsistent and confusing terminology which has been employed. Most tumors of the testis are malignant and of these the great majority are derived from aberrant sex cells. Tumors so derived may exhibit differentiation into teratomatous elements or they may be homologous tumors composed of atypical germinal epithelial cells. For the latter the term "embryonal carcinoma" seems most appropriate, although "seminoma" has been used interchangeably. That such a practice is objectionable lies in the fact that the terms "seminoma" and "spermatocytoma" were introduced by French writers, particularly Chevassu (1) who believed that such tumors were derived from the epithelium of seminiferous tubules (adult spermatoblasts). American investigators have not subscribed in the main to that theory.

To make the subject more complicated, the term "adenocarcinoma" has been applied to those embryonal carcinomas in which the cells have become arranged to form tubules or even suggest a tubular arrangement. Therefore, most adenocarcinomas encountered in the literature are actually embryonal tumors. Much of the literature deals with malignant neoplasms developing in undescended or incompletely descended testes.

That other than embryonal or sex cell tumors of the testis exist is well attested in the literature. Fibroma, spindle cell sarcoma, lymphosarcoma, interstitial or Leydig cell tumors, Sertoli cell tumors, adenoma and adenocarcinoma have been reported and described by various authors. Lymphosarcoma may be a variety of teratoma. It is assumed that there is a definite histogenetic relationship between adenoma and adenocarcinoma.

Kaufmann (2) states that pure tubular adenomas of the testis are very rare but that they may occur as multiple light yellow nodules and refers to the work of Pick, Lecene, Chevassu, and himself. He

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further states that their development from Sertoli's cells of pre-existing seminiferous tubules has been proved quite definitely. In Kaufmann's textbook are two illustrations of adenocarcinoma of the testis. One is a photograph of the gross specimen and the statement is made that "epithelial cells formed typical gland structures with a lumen in the center." The other illustration is a photomicrograph of a tumor which weighed 1,170 grams in a 50-year-old patient.

Ewing (3) refers to three cases reported by Bell (4) and one by Stevens and himself (5). He designates them as adult multicystic adenocarcinomas, and describes them as occurring in adults, growing slowly and attaining considerable size with no metastasis over a 2- or 3-year period. He states that they arise from adult tubules and are not embryonal or teratoid.

A case of "early adenocarcinoma of the testis" has been reported by Pace (6). From his microscopic description, however, the diagnosis was apparently incorrect inasmuch as the term "embryonal" was not employed. This is frequently the case. We believe that the term "adenocarcinoma of the testis" should be strictly applied to those epithelial tumors primary in the testicular parenchyma with cells arranged in a tubular pattern.

Adenocarcinoma of the testis in a child 2 years old has been reported by Matuyama and Lee (7) and papillary adenocarcinoma of the testis by Kashikura (8). Seminiferous epithelioma has been described by Peyron (9). Adult carcinomas have been reported in the dog and horse by Schlotthauer, McDonald, and Bollman (10). Innes (11) described 15 cases of tubular adenoma (Sertoli cell tumor). Spermatogenic carcinoma has been described by Allen (12). Meyer (13) has reported adenomas of the rete testis.

A case of adult carcinoma of the testis in a 47-year-old man for which simple orchidectomy was performed is reported.

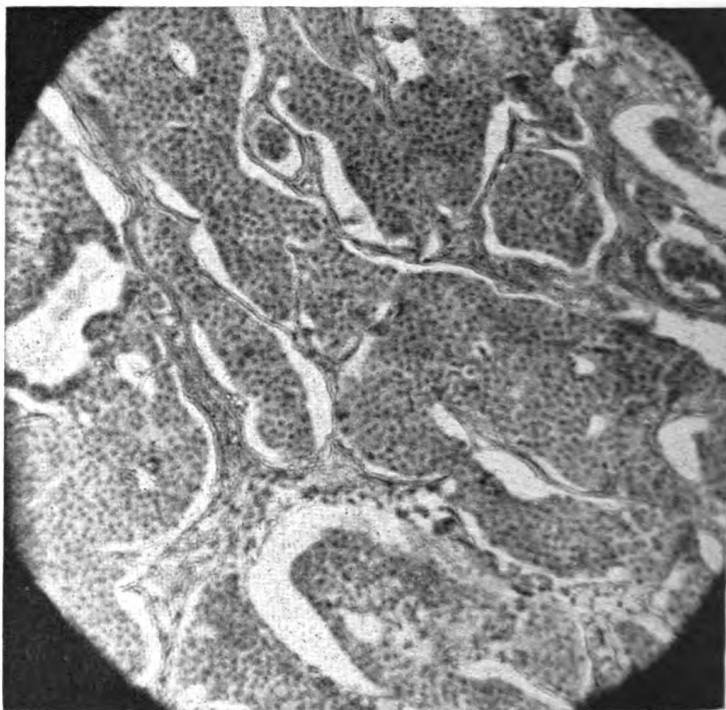
CASE REPORT

J. M. N., fireman, first class, USN, was admitted October 28, 1942, to the hospital, complaining of swelling of the right half of the scrotum of 2 to 3 months' duration. Swelling was slightly painful, but did not annoy him sufficiently to cause him to consult a physician. He thought it was due possibly to a slight injury. The pain had increased slightly during the week previous to his admission, and he therefore sought relief. He denied all previous illness, including venereal disease, and a systemic review failed to reveal any symptoms except an occasional headache. The family history was entirely negative. He is a moderate user of alcohol, tobacco, and coffee, and his habits are otherwise good.

Physical examination showed a well nourished, well developed white adult male, weighing 170 pounds, and apparently not acutely ill. Except for the local condition, no pathological signs were evident. The right testicle was swollen to about twice its usual size and slightly tender. Slight fluctuation was present, but the fluid did not permit transillumination. The epididymis was distinctly outlined, hard and smooth. Rectal examination was negative and there was

no local adenopathy. Routine blood and urine examinations were negative. The Kahn test was negative on two examinations; Mantoux test positive 1:10,000; urine negative for tubercle bacillus; prostatic fluid negative both for pus cells and bacteria. X-ray of chest showed no evidence of heart, lung, or great vessel pathology. A diagnosis of chronic epididymo-orchitis was made, and orchidectomy performed on November 2 under spinal anesthesia.

On opening the scrotum a small hydrocele was seen, and the sac incised with escape of about 30 cc. of straw-colored clear fluid. The testicle and epididymis appeared matted together, dark in color, and very vascular. The spermatic cord was ligated above the external ring and the mass excised. The patient



1. Adenocarcinoma of the testis

made an uneventful recovery and was discharged on November 16, apparently well.

Through some unaccountable delay, the specimen was not examined for several days and the pathological report not delivered until November 23. The patient was immediately requested to return for further examination. A test for prolan A in the urine was negative. The skull, chest, long bones, spine, and abdomen were negative for x-ray evidence of metastases. The patient felt well, had gained 10 pounds in weight, and had no complaints. He was presented before a tumor conference, which recommended that no further therapy be instituted at this time, but that he return for observation and study every 2 months for an indefinite period.

PATHOLOGICAL REPORT

Gross description.—The specimen consisted of an oval encapsulated mass measuring 7 cm. by 5 cm. with 2.5 cm. of spermatic cord attached. The surface was smooth, glistening, and grayish white. Externally the appearance was that of an enlarged testis. The attached epididymis was essentially normal. In section, normal testicular parenchyma could not be recognized. The cut surface was mottled gray, brown, and pink, the consistency varying from firm to soft. In one area of softening there was an apparently calcified area 1 cm. in diameter.

Microscopical description.—All of the sections represented a neoplasm with a surrounding zone of testicular parenchyma and tunica albuginea. The neoplastic cells were epithelial in type, medium sized, with faintly basophilic cytoplasm (fig. 1). Cell size was uniform and there was little variation in nuclear size and staining intensity except for the presence of a few giant nuclei. A few mitotic figures were present. The soft central areas consisted of necrotic tumor tissue. The neoplastic cells were arranged into cords separated by a delicate connecting tissue stroma. In some of these cords a definite lumen could be recognized. Beneath the tunica the remaining atrophic testicular parenchyma was infiltrated by tumor cells.

The calcific area, when decalcified, was found to be an area of ossification. Between the hypertrophied trabeculae there was infiltration of tumor cells. It was apparent that this area of ossification represented a degenerative change, probably secondary to necrosis, and should not be considered a teratomatous element.

SUMMARY AND CONCLUSIONS

Primary adult nonembryonal adenocarcinoma of the testis is a rare lesion.

Terminology is usually not concise and the true incidence of this disease is difficult to determine from the literature.

A distinction should be made between true adenocarcinoma and embryonal carcinoma or embryonal adenocarcinoma of the testis, not only for the sake of academic accuracy but because, in the former, the degree of malignancy is lower, metastasis is less likely to occur, surgical therapy is more effective, and postoperative survival should be longer.

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TOXIC EFFECTS OF PROMIN

Promin is an effective therapeutic agent for the control and the cure of experimental tuberculosis in guinea pigs. Promin has also been used successfully to combat infections which were induced by hemolytic streptococci, by pneumococci or by gonococci.

Promin is a toxic drug and in large amounts may kill an animal.

Promin exerts a direct toxic effect on the erythrocytes, manifested by the presence of abnormal hemoglobin pigments in the cells and by changes in the surface membranes, so that in fresh "cover slip" preparations many cells are crenated.

Damaged erythrocytes are removed from the blood stream by the spleen. Anemia is induced, the spleens are greatly enlarged, and percentages of reticulocytes are elevated.

The anemia is a hemolytic anemia, although some of the features of familial hemolytic (spherocytic anemia) were not present. The erythrocyte volume was increased, spherocytosis was absent, and resistance to hypotonic salt solution was increased.

The blood and the spleens were excessively dark. Spectrophotometric analysis showed the presence in the erythrocytes of sulf-hemoglobin, methemoglobin and an additional unidentified pigment which had an absorption band intermediate between those of sulf-hemoglobin and methemoglobin.

Promin did not induce any permanent damage of the bone marrow. Regeneration of erythrocytes, indicated by reticulocytosis, macrocytosis, and polychromatophilia, proceeded in the face of continuous administration of large amounts of the drug.

Morphologic changes, induced in erythrocytes in vivo by promin, may be observed in in vitro preparations as well.

Although the drug is toxic, no permanent damage to any part of the organism was observed when sublethal doses were given.—Higgins, G. M.: Toxic effects of promin (sodium P,P'-diaminodiphenyl-sulfone-N,N'-didextrose sulfonate) on the erythrocytes of guinea pigs. *Am. J. M. Sc.* 205: 834-841, June 1943.

THE DISPOSITION OF PATIENTS STIGMATIZED WITH RHEUMATIC DISEASE. III^{1 2}

ALVIN F. COBURN

Lieutenant Commander (MC) U. S. N. R.

No medical case challenges the judgment of a board of medical survey more than the problem of disposition of rheumatic patients who have been in bed for at least 6 weeks, and usually in the hospital for more than 3 months. No general rule will cover all cases; each patient's problem is unique and must be considered individually and decided on its own merits. The interests of the United States Government in a state of emergency and the future welfare of the patient must be given careful consideration (40).

Once a patient has manifested rheumatic activity he must be considered a rheumatic subject always susceptible to a recrudescence of his disease. The possibility of a recrudescence is contingent upon many factors. Some of these are the age of the patient, his degree of susceptibility and the chance of reinfection with group A hemolytic streptococcus. The age of the patient is known; the degree of susceptibility can be only roughly estimated; the occurrence of infection is a matter of chance, depending upon the naval activity to which the patient is attached. If at sea, or assigned to duty in the South, he may escape the infectious agent prerequisite to the initiation of rheumatic fever and enjoy greater protection than if working as a civilian in a city of the temperate zone. If stationed at a North Atlantic port, he is exposed to, but may, nevertheless, escape infection. Data collected over a 15-year period by the author indicate that the expectancy for hemolytic streptococcal infections among adolescents in New York City is approximately one infection per patient each 3 years. The incidence of infections is probably lower among adults in the general population but may be higher at a receiving ship with a rapid turn-over of recruits.

¹ Received for publication December 22, 1942.

² This is the last of a series of three articles by Dr. Coburn on aspects of rheumatic fever. The others appeared in the July and September BULLETINS.—*Editor*.

Some of the questions which must be considered before a fair decision on disposition can be reached are:

1. Is the patient's training and equipment needed by the United States Navy in the present emergency?
2. Did his condition exist prior to enlistment?
3. Will his heart muscle stand any strain of duty afloat or ashore?
4. Will he be subject to a rheumatic recrudescence within 3 years; in other words, does he appear more susceptible than the average rheumatic subject?

The method used in making disposition of these rheumatic patients was a clinical appraisal of each case with due consideration being given to each of the points just discussed.

An alternate method was devised whereby a numerical value was assigned to each of four important factors and the total considered significant. Although no decisions were made on the basis of the patient's score, it was observed that there was a close correlation between the clinical appraisal of each case and the evaluation determined by this method. The factors considered important to the patient's future usefulness to the United States Navy and scored in an evaluation table were:

1. Extent of residual cardiac damage.
2. Severity of rheumatic attack.
3. Age of patient.
4. Apparent degree of susceptibility.

Each factor was scored from 0 to 4+. The lowest total for an initial rheumatic attack in an older man with mild rheumatism and minimal cardiac involvement was 5; the highest score was the maximum of 16 in a fulminating rheumatic attack. The scoring was made in the following manner:

1. *Extent of residual cardiac damage.*
 - 4+ Pancarditis with heart failure.
 - 3+ Aortic insufficiency and mitral stenosis, impaired myocardial reserve.
 - 2+ Mitral lesion definite, but satisfactory myocardial function.
 - 1+ Systolic apical murmur, no cardiac symptoms during illness and no impairment of function.
 - 0 No detectable evidence of heart involvement during or after attacks.
2. *Severity of rheumatic attack.*
 - 4+ Fulminating.
 - 3+ Severe, polycyclic.
 - 2+ Mild polycyclic or severe monocyclic.
 - 1+ Mild monocyclic or vague symptoms with EKG changes and elevated sedimentation rate.

In judging severity, the blood sedimentation rate was taken into consideration.

3. *Age.*—The younger the rheumatic subject the more susceptible he appears to be. Recrudescences after the age of 17 years are less likely than in the puberty period. There seems, however, to be a continued decreasing susceptibility.

at least to cardiac damage, with increasing age; an arbitrary system of scoring was made:

- 4+ 17, 18, 19 years.
- 3+ 20, 21, 22 years.
- 2+ 22 to 30 years.
- 1+ 30 to 40 years.
- 0 over 40 years.

4. *Apparent degree of susceptibility.*—This factor is extremely difficult to evaluate. In attempting to assign a value to apparent susceptibility, consideration was first given to the prevalence, rarity, or absence of rheumatic fever in the environment from which the patient came, the age at which the patient developed his first attack, the possibility of exposure to hemolytic streptococcus since entering the Navy.

- 4+ (a) Repeated attacks during childhood in a rheumatic environment.
(b) Severe rheumatic attack following first throat infection after entering the Navy from a non-rheumatic environment.
- 3+ Attack in childhood.
- 2+ No attacks in childhood in an environment where rheumatic fever occurs and no attack during first year in the Navy.
- 1+ No attack until after repeated throat infections in the naval service.

In brief, an attempt was made to determine to what degree the patient had been exposed to hemolytic streptococcus infections and his reaction to this respiratory pathogen.

The results of this system for evaluation show that 4 patients scored over 12 points, 44 scored below 9 points; 18 scored 9, 10, 11 or 12. On the clinical evaluation all patients who had scored above 12 seemed unsuitable for duty in the United States Navy; whereas all patients with a score below 9 seemed fit for duty. Difficult to evaluate clinically was the intermediate group scoring between 8 and 13. Three of these patients were discharged; all had an EPTE³ history and cardiac valvular disease on admission to the hospital. The remainder scored only 1 plus on the residual cardiac damage and were believed fit for duty although susceptible to a rheumatic recrudescence. Their future usefulness will probably be determined by their exposure to hemolytic streptococcal infections, in turn dependent on the geographical environment of the naval activities to which they are attached.

The final disposition of the entire group of patients was in most instances return to duty. Seven patients were invalided from the service because of heart disease and marked rheumatic susceptibility. Five of these had an EPTE history, had been in the naval service only a few months, and had had long-standing valvular heart disease. Two had escaped rheumatic fever in their home environment, had developed a severe rheumatic attack after their first throat infection a few months after entering the Navy, and required prolonged convalescence at a Veterans' Administration Hospital.

³ Existed prior to enlistment.

Final disposition of these patients was determined solely by appraisal of the clinical picture, length of service in the Navy, and EPTE status. It is of interest, however, that had this method of numerical evaluation been employed, the recommendations would have remained unaffected.

DISCUSSION

Each rheumatic patient presents an individual problem which tests the medical officer's understanding of the rheumatic process and his therapeutic skill in handling a great variety of clinical manifestations. Fundamental to this understanding must be a clear conception of the close association of the initiation of rheumatic activity to hemolytic streptococcal infection of the upper respiratory tract. In the author's opinion, this association is as close as inhalation of ragweed pollen and the hay-fever subject's reaction to this antigen. Hay fever is initiated by the protein of a plant; rheumatic fever, by some product of group A hemolytic streptococcus. Both occur when the appropriate antigen is prevalent and only among constitutionally susceptible subjects. When ragweed pollen disappears from the air the hay-fever subjects may lead a normal life, and when streptococcal activity subsides the rheumatic subject may also regain the ability to live naturally. One striking difference, however, is the time required for the return of pre-disease capacity for work. In the hay-fever subject the involved respiratory tissues recover rapidly with the subsidence of disease activity; in the rheumatic subject the heart-muscle damage must be repaired and in this organ, on which the body's demand for work are exacting, the repair processes are slow. It is for this reason that great care must be given to the rheumatic patient not only during his illness but also throughout convalescence and into recovery. Without this care the patient may be handicapped by a poor myocardium, a future liability to himself as well as to the Navy.

In a civilian population the incidence of rheumatic fever is much greater than is generally known. Davidson's studies (41) in Scotland indicate that 335,000 new attacks of rheumatism occur annually in Scotland's 5,000,000 population and that of these there are at least 26,000 cases of rheumatic fever. The living conditions associated with training a tremendous armed force are such that the incidence of rheumatic fever can be expected to increase. In the Navy, rheumatic fever is manifesting itself among three groups:

1. Individuals with rheumatic heart disease whose lesions escaped detection on the initial physical examination.
2. Individuals who, in their patriotic enthusiasm, denied a previous rheumatic attack.
3. Individuals who escaped exposure to hemolytic streptococcal infections in their home environment.

These three groups are rheumatic subjects with varying degrees of susceptibility to the development of the rheumatic reaction; all may be expected to develop rheumatic recrudescences with repeated streptococcal infections. Fortunately, however, most Navy personnel are of the age group in which myocardial damage is not severe and the environment afforded by Navy life, with the exception of training centers, usually protects the individual from exposure to repeated streptococcal infections. It is for these reasons that the author considers it wise to return to duty men who have developed their first attack of rheumatic fever in the Navy, who have completely recovered from the attack and whose myocardial reserve is adequate to the physical demands of life afloat or ashore.

The invaluable studies of Lancefield (42) and the patient teachings of Swift (43) now make it possible for the biologist to diagnose group A streptococcal infections with accuracy and also for the clinician to comprehend the natural history of rheumatic disease. It remains for those entrusted with hospital management to supply adequate laboratory facilities and environments appropriate for practicing what years of experience have taught. It is essential that rheumatic patients be placed on special wards restricted to the treatment of this disease, where under the care of an experienced staff, adequate rest can be secured and a high morale can be maintained. Satisfactory convalescence cannot be effected in a large general hospital of a northern city where environmental conditions predispose not only to repeated streptococcal infections but also to the continuation of infections already established. There is great need for the establishment of a convalescent rheumatic hospital in an appropriate warm climate where, according to the facts now available, convalescence can be shortened and heart muscle damage reduced to a minimum. The availability of such facilities, together with a clear comprehension of the rheumatic problem, will bring to realization the goal of keeping "as many men at as many guns as many days as possible."

In conclusion, it is apparent that conditions existing in naval training centers are comparable to those created in experimental epidemiology and full recognition must be given to the fact that during an experimental epidemic, a micro-organism increases its infectivity (44). It can be anticipated that under present conditions hemolytic streptococcus will develop variants, some of which will acquire a great capacity to spread. These variants, having then become epidemic strains, will initiate disease processes, doing incalculable damage to Navy personnel. It is essential that these facts be recognized because, to be effective, preventive measures must be instituted as early as possible in the epidemic process. Failure to meet this challenge will permit the natural evolution of an epidemic with the spread of streptococcal diseases.

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TRAINING OF THE MEDICAL DIVISIONS OF UNITS ASSIGNED TO DUTY OVERSEAS ¹

SAMUEL C. LIND—

Commander (MC), U. S. N. R.

The organization and training of medical units before their departure from the continental limits of the United States is necessary to increase their efficiency and insure their smooth operation. An account of the experience gained in training the corpsmen and the medical officers attached to ——— should interest those serving with similar groups and perhaps assist them in their training program. How much can be accomplished depends on the time lapse between the assembling of the unit and its departure, and the relationship of the point of assembly to a medical center. We have been particularly fortunate in being at not too great a distance from large, well-staffed civilian hospitals, as well as Government hospitals. Both have made their facilities available for the training program and have given cordial and understanding cooperation.

When a Medical Division is assembled one of the first items is to detail the medical officers to teaching duties for which their special training and interests particularly fit them. Orthopedists can be expected to instruct in bandaging and transportation of injured, the surgeons in first aid, and the internist in medical aspects. In addition to this, the medical staff will have what may be called housekeeping assignments, such as the daily sick calls, dental work, insurance examinations, sanitary inspections, and the other assignments which are customarily discharged by a station medical group. Two or three of the officers should check and recheck the medical property list, so that omitted items and items which seem inadequate can be requisitioned and increased allowances requested. However, we found our medical and surgical supplies in the main quite satisfactory. Those in charge of furnishing units such as ours with these items have given the matter careful thought, and, all things considered, have done a first-class job. Obviously it is impossible to include all of the pet instruments and drugs which some of the doctors want, and, indeed, similar instruments and drugs which are furnished will do the work. At the same time we would gladly exchange an electrocardiograph

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which is in our equipment for a foreign-body locator, certain that the latter would be more useful and practical for an overseas unit. Again, a few omitted instruments such as airways and a dermatome have been made by the mechanics attached to us. However, let me repeat, the instruments and drugs allotted are in the main well selected and adequate.

Completing inoculations, re-examining the personnel, checking the health records, making x-rays of the chest where this has not been done, and performing essential dental work should be begun at once, and medical officers should be detailed for these activities. The psychiatrist interviews, examines, and makes recommendations concerning those presenting psychiatric problems. The mentally unstable should be eliminated and replaced. All this should be gotten under way at the earliest possible moment, and completed as rapidly as possible. Of equal importance is the problem of sanitation. Two doctors should be appointed as sanitation officers and a dozen or more corpsmen assigned to them for instruction, in both the practical and theoretical aspects of the subject. The medical officers must study the subject, visualize the problems of sanitation with which they may reasonably expect to be confronted at their probable destination. If a unit has one or more medical officers who have had experience and training in this field, it is indeed fortunate. Nearby civilian centers may be of service, as was the case with us. For example, courses in mosquito identification and control, as well as practical training in water analysis, both chemical and bacteriological, were given to certain of the medical officers and the corpsmen of the sanitation detail.

A medical officer should be designated in connection with methods useful in defense against chemical warfare. A certain number of hospital corpsmen should be assigned to assist him and to be taught decontamination procedures together with the procedures used in treating casualties resulting from attacks in which chemical agents are employed. All should be instructed in the use of the gas mask.

In addition to all this a survey should be made to find out what the nearby medical schools and hospitals have to offer in the way of refresher courses for doctors, if the outgoing unit is not too far away from a medical center. Two definite advantages result: First, the medical officers are helped professionally, and become more valuable to the organization; second, they are kept busy. One of the big problems confronting an overseas unit is how to employ profitably the medical officers while awaiting final orders. Time hangs heavy on their hands. The routine medical work is easily handled by a few and the rest are relatively unoccupied. Having lectures for them, assigning them as teachers of corpsmen helps keep them busy, but is far from being a

complete and satisfactory answer. So, certain ones may be sent to refresher courses.

Our medical officers have had the following courses:

	<i>Officers</i>
Anatomy (12 days).....	5
Chemical warfare (10 days).....	8
Tropical medicine (7 days).....	6
Orthopedic surgery (6 weeks).....	4
Thoracic surgery (4 weeks).....	3
Anesthesia (6 weeks).....	1
Anesthesia (2 weeks).....	4

All attending these courses found them very much worth while. Undoubtedly the quality of medical work will be better as a result of them. We all feel deeply indebted to the civilian doctors, who gave so freely of their time and energy, unrewarded except for the satisfaction which comes from knowing that they have made a very distinct and definite contribution to our war effort.

The instruction of the hospital corpsmen is of utmost importance and is the responsibility of the medical officers. It is their duty to set up a program and follow it through. Specific subjects must be covered and instructors should be those medical officers best qualified in the particular field. The lectures and quizzes reveal the strong and weak points in the corpsmen's knowledge and assist in the selection of those qualified for advanced training.

All of us realized that a review of basic subjects was needed. Most of our corpsmen, indeed the great majority, were hospital apprentices, second class, and had had limited practical experience. Many had forgotten what they had been taught. This difficulty had to be corrected, and a series of lectures on anatomy, physiology, and first aid was the first step in their education. Quizzes on definite assignments in the Handbook of the Hospital Corps compelled the men to read the book and fixed the material in their minds. Had we done no more than this, definite benefits would have resulted. Practice in bandaging and litter carry was given and given again until a reasonable degree of efficiency was attained.

With this preliminary spadework out of the way, the situation in nearby hospitals was canvassed, and we were able to place small groups for special training. Included in this were 16 men who received 8 to 10 weeks in the operating room of a large general hospital where they acted as assistants at major surgical operations, were taught aseptic technic together with sterilization of instruments and dry goods. They acquitted themselves with credit, and their work received very favorable comment from the supervisor of surgery. Over 50 received from 4 to 6 weeks' training in naval hospitals where they served on the wards and in the dressing rooms. Specialized instruc-

tion was given others. For example, 12 worked for 6 weeks on the wards of a hospital devoted entirely to the treatment of mental diseases. Sixteen were given instruction in sanitation through lectures, building of latrines, constructing garbage disposal facilities, while 4 were given intensive training in mosquito identification. Three spent 2 weeks in the laboratory of a city water department, perfecting themselves in both the chemical and bacteriological examination of water. Four were trained as x-ray technicians, 3 as assistants in the eye, ear, nose, and throat department, while 1 chose physiotherapy as his field. In addition to all this, 8 men received a 10-week period of instruction in aviation medicine, and were assigned to the medical officers in charge of this activity. Ten had advanced, intense, and actual practice in decontamination measures.

Instruction was given in extra-medical activities, such as swimming, close and extended order drill, the manual of arms, judo, and practice in the property, accounting, and record offices, while a somewhat larger number were required to learn truck driving, winch operation, and the erection of tents and Quonset huts. The net result has been a tremendous gain. Today these men are qualified to discharge their various assignments competently and efficiently. The hospital division is now prepared to render far better service than would have been the case had this training been neglected.



CERVICAL AND ANOMALOUS RIB FORMATION

Roentgenological incidence of cervical ribs and anomalous rib formation in a mass chest survey of 15,000 women at a Women's Reserve Training School revealed 38 cases of cervical ribs, giving an incidence of 0.25 of 1 percent. Of these 38 cases, 23 had bilateral cervical ribs, 10 had a cervical rib on the right side only, and 5 cases had a cervical rib on the left side only. Not one case admitted symptoms or demonstrated any findings suggestive of clinical pathology.

There were 13 cases of rib anomalies, giving a percentage of 0.1 percent. These anomalies consisted of fusion between the first and second ribs, or first rib and sternoclavicular junction. Of these 13 cases, 9 were right-sided fusions, 1 was a left-sided fusion, and 3 cases were fusions between the first rib and sternoclavicular junction. In the case of rib anomalies, not one case admitted symptoms suggestive of clinical pathology.

Three of the 38 cases of cervical ribs had associated significant pulmonary tuberculous lesions. However, cervical rib could in no way be interpreted as being a predisposing or associated factor with the occurrence of these tuberculous lesions, because the incidence of association was the same as the tuberculous incidence of the entire 15,000 recruits.—Brown, Leo J., Lieutenant, junior grade (MC) U. S. N.

THE EARLY CARE OF NASAL FRACTURES ¹

MICHAEL M. GURDIN,

Lieutenant Commander (MC), U. S. N. R.

Due to the exposed and prominent position of the nose, nasal fractures are extremely common. The correct reduction and early care of these fractures will reduce the high incidence of permanent deformity and disabling sequelae. Often a fractured nose is passed off as just another "bloody nose" or, at times, even when fracture is suspected no attempt is made at reduction. The satisfactory early care of nasal fracture is more a matter of technic than of special equipment, and both are simple enough so that over 75 percent of these fractures can be intelligently treated by a medical officer without special surgical training, or by a well-trained pharmacist's mate on independent duty. It is to be borne in mind that the simple technic described in this paper will not suffice to treat severe compound fractures of the nose or fractures of the nose associated with fractures of the other facial bones. These injuries must be recognized and left to the care of one specially trained in the treatment of such injuries.

Diagnosis.—Any history of facial trauma followed by epistaxis should immediately suggest a nasal fracture. The following points are to be noted on examination:

1. Epistaxis.
2. Swelling and ecchymosis, which usually involves the nose and medial half of the eyelids.
3. Gross deformity of the nose (flattening or deviation from the midline).
4. Crepitation of the nasal bones.
5. Tenderness.
6. X-ray evidence of fracture.

The absence of x-ray facilities is certainly no excuse for failing to diagnose or treat a fracture of the nose. Although desirable, x-rays are not necessary and, unless taken and interpreted by an expert, they are apt to be unreliable.

The examination should be thorough, and an exact diagnosis made of the type of fracture (compound, comminuted, etc.), the direction and degree of displacement (lateral, posterior, etc.), and of the presence of a fracture or displacement of the septum. Only when this is accomplished can an intelligent attempt at reduction of the fracture be made. Since swelling may make accurate diagnosis difficult soon after injury, there is no contraindication to waiting several days until

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the swelling subsides. A satisfactory primary reduction can be accomplished up to about 14 days after the accident.

Preoperative care and anesthesia.—If the fracture is to be reduced immediately, the nares are cleansed of blood clots and packed with cotton strips moistened with a solution of equal parts of 20 percent cocaine hydrochloride and 1:1,000 epinephrine hydrochloride. This solution produces hemostasis, anesthesia, and shrinking of the nasal mucosa. In addition to the topical anesthesia, local infiltration with 1 percent procaine may be used, but general anesthesia is preferable to local infiltration as the latter is difficult to administer in sufficient quantity to be effective without causing distortion that will influence the reduction. Intravenous pentothal sodium is the anesthetic of choice if proper precautions are taken to prevent the aspiration of blood into the respiratory passages.

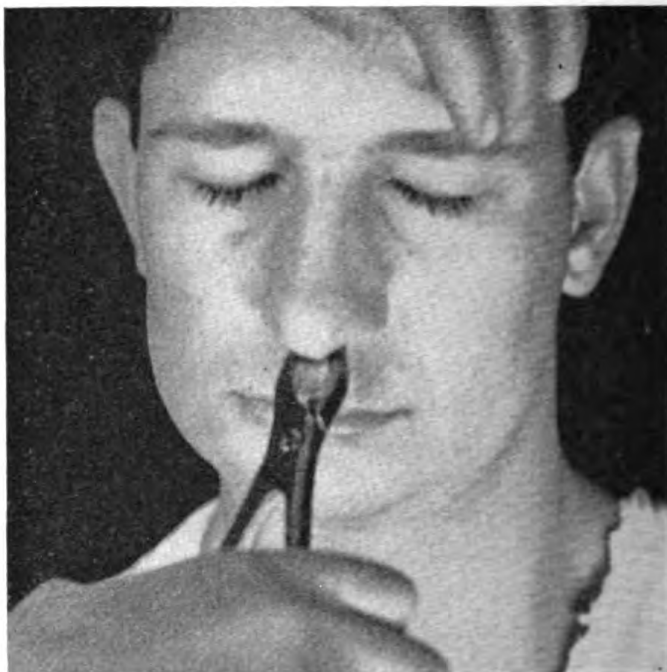
If one decides to wait until the swelling subsides, the patient is put to bed in a semisitting position, given mild sedation, such as codeine and aspirin, and cold compresses are applied to the nose and the eyelids. The patient can do this for himself if a small basin of ice water is placed at the bedside. No attempt is made to cleanse the clots from the nose the first 24 hours, and no nasal packing is used unless the bleeding is profuse. Packing forces the hemorrhage into the subcutaneous tissues causing increased swelling, ecchymosis, and deformity. When bleeding is severe enough to necessitate packing, the clots are first removed (by applicators or suction, not by blowing the nose) and a half-inch gauze packing moistened with epinephrine solution 1:1000 is inserted firmly enough to control the hemorrhage. This packing is carefully removed in 12 to 24 hours. The interior of the nose is gently cleansed twice daily with applicators soaked in hydrogen peroxide 3 percent and the inside of the nose is anointed with sterile vaseline after each cleansing. Keeping the nasal passages open promotes drainage and more rapid reduction of the swelling. Ordinarily, 2 to 3 days of this treatment will result in the disappearance of the swelling to a degree permitting correct diagnosis and treatment.

The reduction of the fracture.—A satisfactory reduction produces normal form and function. The reduction of a nasal fracture is simplified if we bear in mind that the fragments can be manipulated between an instrument inserted into the nares and the fingers applied externally.

After anesthesia the interior of the nose is cleansed and a careful reexamination is made with special emphasis on the diagnosis of septal displacement. If the latter is present, the blades of the Asch forceps are applied to either side of the septum, the handles are grasped firmly,

and, by traction and manipulation, the displacement is reduced (fig. 1).

For reducing comminuted fractures a knife handle or a medium sized Kocher clamp is inserted into the nares for internal pressure and the thumb and index finger of the left hand apply the external counterpressure. The internal instrument pushes out any depressed or medially displaced fragments; then, using this same instrument for counterpressure the nasal bridge is molded into shape with the fingers externally (fig. 2).



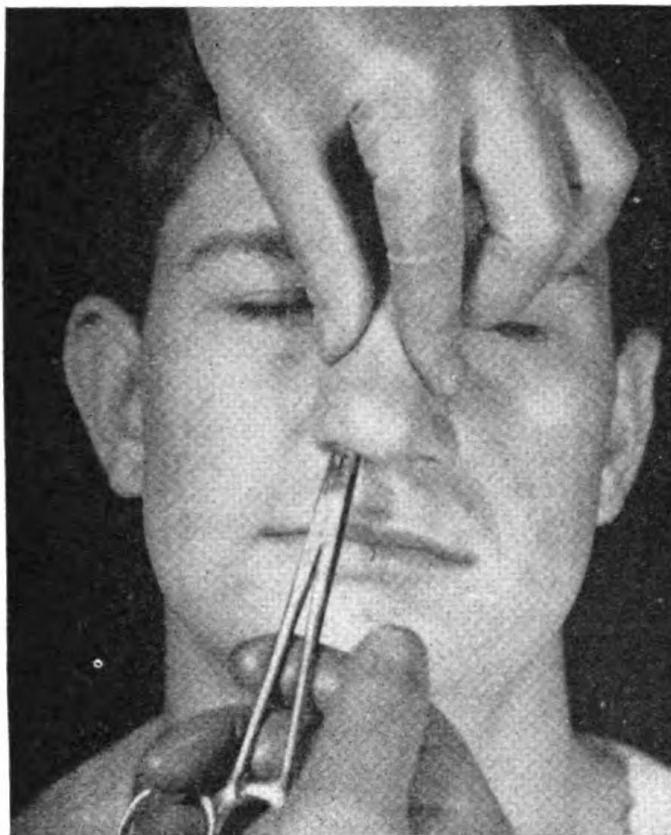
1. Reducing septal displacement. The Asch forceps are applied to the sides of the septum, grasped firmly, and by traction and manipulation the septal displacement is reduced.

In less comminuted fractures, where the nasal arch is fractured and rotated en masse, reduction is more easily accomplished by the use of the Asch forceps. The blades of the forceps are applied to the displaced nasal arch with one blade internal and the other external. The handles are grasped firmly and by a twisting motion the nasal arch (nasal bone and nasal process of the maxilla) is rotated back into position (fig. 3).

Occasionally a fracture is seen in which both nasal arches are fractured at their bases and at the nasofrontal suture with lateral displacement of the nasal arch en masse. In these cases, sharp pressure with the thumbs against the convex side will push the bridge back to the midline (fig. 4).

Packing and splinting.—The nasal bones have no muscular pull and,

theoretically, once properly reduced need only protection from external violence to remain in that state. Practically, however, these fractures are generally accompanied by cartilaginous displacements which cannot be completely reduced at the original operation and have a tendency to cause secondary displacements unless the nose is properly splinted for 5 to 7 days (fig. 5). It must be borne in mind that splints

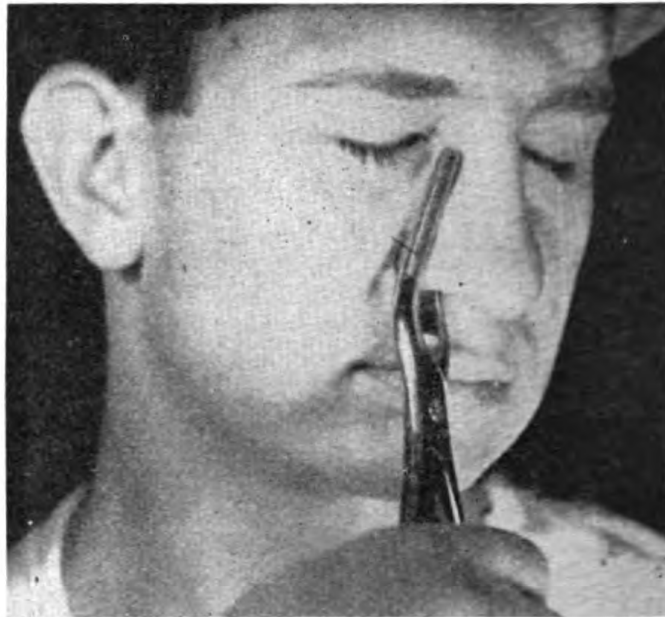


2. Reduction of a comminuted depressed fracture. The closed clamp blades internally push the fragments out. Then, using this same instrument for counterpressure the nasal bridge is molded into shape with the fingers.

will hold a properly reduced fracture but, in themselves, they will not reduce the fracture.

The rules for nasal packing are as follows: First, pack only when indicated; second, pack as lightly as is consistent with the needs of the case; and third, remove the packing as soon as it has served its purpose.

Packing is indicated to control hemorrhage and to provide internal splinting after reduction of depressed or comminuted fractures. For this one uses either Simpson nasal splints (compressed cotton wads which are cut to fit the interior of the nose and which expand as they absorb the nasal secretions) or half-inch vaseline gauze packing.

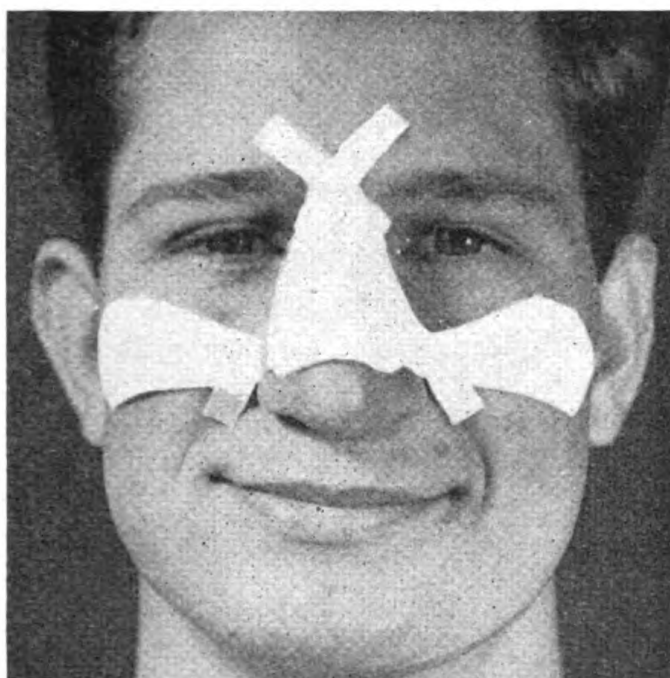


3. Reduction of a rotated nasal arch. The blades of the Asch forceps are applied with one blade internal and the other external; the handles are grasped firmly and by a twisting motion the nasal arch (nasal bone and nasal process of the maxilla) is rotated into position.



4. Reduction of nasal arch displaced en masse. Sharp pressure with the thumbs against the convex side pushes the bridge back to the midline.

Simpson splints are most useful following the reduction of medial displacement of the nasal arch. If used, they should be cut to proper size and carefully greased with vaseline before insertion. The vaseline gauze packing may be used in this type of fracture also, but is most valuable in nasal hemorrhage or depressed-comminuted fractures as it may be firmly packed at the fractured or bleeding site and lightly packed into the remainder of the nares. Simpson splints or other packing should be removed in 24 to 48 hours. Packing delays the resolution of swelling and predisposes to infection, and should be removed as soon as it has served its purpose. If carefully removed, very little bleeding will ensue. If a bleeding point is encountered, it can be controlled by applying 10 percent silver nitrate solution. After remov-



5. External splinting. The metal splint is covered with adhesive, bent to fit the nose, and fixed to the nose with adhesive strapping as shown above.

ing the packing, the clots, dried blood and mucus are carefully removed to insure free air passage and drainage, and the inside of the nose is gently swabbed with sterile vaseline.

Postoperative care.—The interior of the nose is cleansed daily with hydrogen peroxide solution on sterile applicators and is then anointed with vaseline. Since there is considerable discharge from the nose the patient is given a supply of paper tissues with instructions to wipe the nose gently as often as is necessary but cautioned not to blow the nose nor insert anything into the interior of the nose. The external splint is left in place for 5 to 7 days and is reinforced and secured with adhesive if it becomes loose as the swelling subsides. It

is sometimes advantageous, after removing the external splint, to apply warm compresses to the nose and adjacent areas to help relieve swelling.

Complications.—The complications encountered may be:

1. Recurrent dislocation of the fragments.
2. Hemorrhage.
3. Infection.

Secondary displacements or incompletely reduced fragments can be corrected by secondary reduction any time before callus formation (about 2 weeks) occurs. Proceed as described above. Secondary hemorrhage is corrected by either touching the bleeding points with silver nitrate solution or by intranasal packing. If infection occurs, all packing and splints are immediately removed and warm boric acid compresses are applied externally. An attempt is made to keep the nasal passages open by using nose drops and gently removing the clots and crusts of dried mucus. Any such manipulation must be gentle and atraumatic. Localized abscesses are incised and drained. Chemotherapy is started at the first sign of infection.

CONCLUSIONS

Not every nasal fracture can be satisfactorily reduced primarily, but, in all cases with displacement, a reduction should be attempted as soon as the condition of the patient permits. An unreduced fracture means deformity with the possibility of nasal obstruction and chronic nasal and sinus disease, often necessitating a secondary operation.



CAPTAIN RODDIS (MC) U.S.N. AWARDED WELLCOME PRIZE

For the fourth consecutive year the Sir Henry Wellcome Medal and Prize has been awarded to a naval medical officer. The award consisting of \$500 cash and a gold medal for the best competitive essay on "Burns Incident to War. Measures for Their Prevention and for Treatment," was won by Capt. Louis H. Roddis (MC) U.S.N. Lt. Comdr. Samuel G. Berkow (MC) U.S.N.R. received first honorable mention and a life's membership in the Association of Military Surgeons.

INCIDENCE OF DENTAL CARIES AMONG PURE-BLOODED SAMOANS ^{1 2}

JOSEPH S. RESTARSKI

Lieutenant Commander (DC) U. S. N.

Studies in the past regarding the incidence of dental caries among the Samoans included racial mixtures to a greater or lesser degree.³ In the survey reported here, measures were taken to include only Samoans of a pure racial strain. The study was performed in order to compare the incidence of caries between natives living near the Naval Station and those living in the more remote sections of American Samoa.

Geographically the investigation included the four principal islands in the American Samoan group; namely, Tutuila, and the three islands of the Manua group. The native population of these islands, including the racial mixtures, is slightly over 12 thousand people. The survey was performed on 1,970 full-blooded Samoans between the ages of 2 and 21 years. This group roughly comprises over one-sixth of the native population.

At this point it may be well to stress that the present-day Samoan has definitely adopted the white man's mode of living, depending a great deal upon his financial situation. Imported tinned foods are coveted by these people. One may make a trip to any of the most remote parts of the island and discover with comparative ease empty food tins strewn about the village. Difficult mountain trails present no serious obstacle to a Samoan in his trip to a store where he may purchase imported foods, sugar, and white flour. True enough, the average Samoan family living in the remote sections still mainly subsists on native foods; however, to state accurately the degree and frequency of imported foods included in the daily diet would be purely conjecture.

PROCEDURE

All examinations of persons included in this report were carefully made by the author with the aid of sharp explorers and mouth mirrors. Findings were recorded on charts especially prepared for this survey.

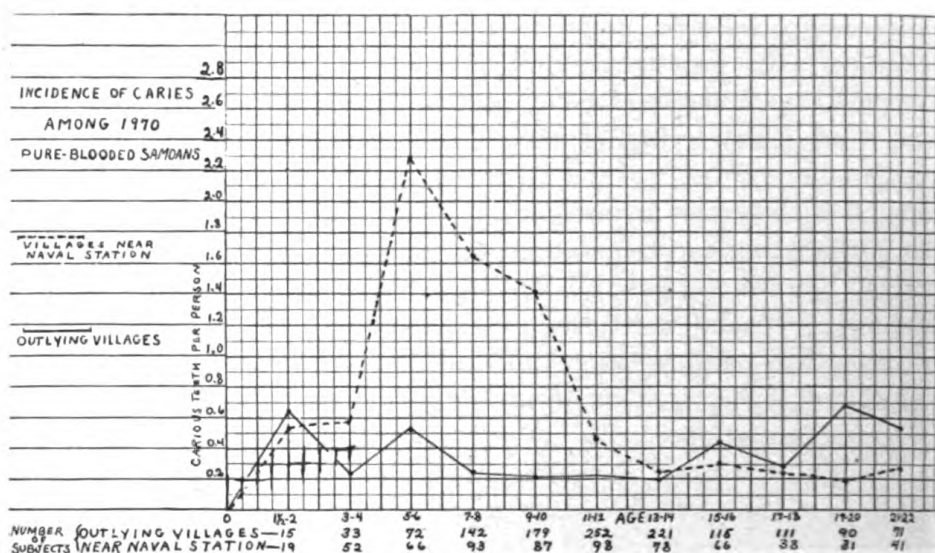
¹ Received for publication April 9, 1943.

² From the Dental Research Department, Naval Medical Research Institute, and the Naval Dental School, National Naval Medical Center, Bethesda, Md.

³ Ferguson, R. A.: Dental survey of school children of American Samoa. *J. Am. Dent. A.* 21: 534-549, March 1934.

FINDINGS AND CONCLUSIONS

Study of the data reveals a marked caries increase in the deciduous dentition of children living in villages within close proximity to the naval station as compared with a similar age group in the outlying sections (chart 1). In the higher age groups there is a similarity in the incidence of caries. Any attempt by the author to conclude the reason for this occurrence, whether it be the result of diet or heredity, would be extremely speculative.



Very few cases of malocclusion were recorded. Of these, 6 displayed a class-2 relationship of the first permanent molars; while only 3 class-3 cases were observed. A number of children presented crowded maxillary and mandibular incisors; however, in the higher age groups this was not apparent.

A report on the estimation of fluorides in Samoan drinking water is hoped to be presented in the near future.

Acknowledgment.—I want to take this opportunity to express my appreciation for assistance rendered by Drs. H. T. Dean, H. L. Klein, and C. E. Palmer in preparing the charts used in this survey; also to Lt. Comdr. C. A. Schlack, Dental Corps, U. S. Navy, and Pharmacist's Mate J. E. Murphy in compiling the data.

Without the able assistance of Puiai, my Samoan dental technician, who acted as interpreter and guide, the elimination of racial mixtures from the survey would not have been possible.

CLINICAL NOTES

ACUTE METHYL ALCOHOL (METHANOL) POISONING ¹

A SYNOPSIS OF THE SUBJECT WITH CASE REPORT

WALTER L. VOEGTLIN

Lieutenant Commander (MC) U. S. N. R.

and

CHARLES E. WATTS

Captain (MC), U. S. N. R.

During the space of 5½ hours on the evening of March 7, 1943, 6 enlisted men consumed the contents of 3 quart bottles supposedly containing ethyl spirits. Thirty-six hours later 5 of these men were dead and the other was critically ill. Analysis of a few drops of the liquid remaining in one of the bottles proved it to be pure methyl alcohol.

The unfortunate occurrence justifies a review of the subject of wood-alcohol poisoning. While a specific treatment for acute methanol poisoning does not appear in the average reference textbook, certain therapeutic measures do exist which may save lives if used sufficiently early. In this paper we wish to call attention to these measures and to emphasize that such patients may be desperately ill without showing any alarming signs or symptoms.

PATHOLOGY

Ethyl or grain alcohol is rapidly oxidized in the body to carbon dioxide and water, and is excreted as such. The oxidation of methyl alcohol, on the contrary, results in the formation of formaldehyde and formic acid. These toxic products are retained and cause severe acidosis. Anatomical changes, which may be temporary or permanent, consist of optic neuritis and secondary atrophy resulting in visual defects ranging from transient scotomata to complete blindness. It is not known whether the optic pathology results from the action of the methyl alcohol itself or from the secondary oxidation products. The physiologic pathology appears to be completely reversible with recovery.

¹ Received for publication April 14, 1943.

DIAGNOSIS AND COURSE

Acute methanol poisoning is suggested by a history of imbibing illicit liquor, blurring of the vision or scotomata (characteristically of the central field), abdominal pain, and negative physical examination. The diagnosis is strengthened by the demonstration of a severe acidosis as shown by a lowering of the carbon dioxide combining power of the blood, and a blood ethanol concentration which may appear to be out of proportion to the slight degree of clinical intoxication present. Headache, nausea, vomiting, difficult cerebration, conjunctival injection, nystagmus, and subnormal temperature may be noted, but are not specifically characteristic. Hemo-concentration is suggested by the elevated erythrocyte count and hemoglobin estimation. It is said that the urine is negative for acetone in contradistinction to acidosis from other causes such as diabetes or inanition. Final diagnosis depends upon the qualitative demonstration of methyl alcohol in the body fluids or excretions, or its identification in the suspected liquor.

Contrary to the initial stimulation which is usually seen following the ingestion of ethyl alcohol, methyl alcohol causes a depression of the medullary centers. This depression may first become manifest just prior to (or coincidental with) the sudden onset of coma which may occur from 8 to 36 hours after the poisoning has taken place. It is to be emphasized that consciousness is often not impaired and that respiration and circulation may remain apparently normal up to the onset of coma. This may lure the observer into an unwarranted optimism concerning the general condition of the patient. The transition from consciousness to coma is characteristically sudden and may be heralded only by the onset or increase in the intensity of existing headache, nausea, or vomiting. Once coma has supervened the blood pressure falls rapidly, respiration becomes rapid and shallow, and one or more convulsive seizures occur. Following one of these the patient may not resume breathing and a respiratory death ensues. It is said that in rare instances the patient may recover after varying periods of coma or convulsions.

TREATMENT

If seen during the absorptive phase, or perhaps in any event, the stomach should be emptied by emetics or with lavage using a 5 per cent solution of sodium bicarbonate. Epsom salts and colonic flushing have been recommended.

Treatment of the acidosis should not be delayed awaiting qualitative identification of methanol but should coincide with the discovery of a plasma carbon dioxide combining power of 40 volumes percent or lower. To this end the oral administration of alkali (sodium bicar-

bonate) or alkaline salts (sodium lactate) is satisfactory if the patient is conscious and able to retain the medication. Otherwise one must rely on parenteral administration. Intravenous solutions of sodium bicarbonate or sodium lactate are preferred. The latter may be obtained commercially in ampules of molar concentration to be diluted with distilled water for intravenous or subcutaneous use. If sodium bicarbonate is used it is freshly made up in sterile distilled water to a concentration of 5 percent utilizing the best aseptic precautions that are compatible with the exigencies of the situation. The sodium bicarbonate in a freshly opened package may for this purpose be assumed to be uncontaminated. In an emergency the patient in severe acidosis should not be deprived of intravenous alkali medication merely because the facilities are not at hand for the preparation of hospital quality solutions. In this connection, it should be recalled that solutions of sodium bicarbonate must not be sterilized by boiling or autoclaving.

When the carbon dioxide combining power of the blood is known, Hartmann and Senn² have proposed a formula for calculating the amount of alkali necessary to restore the serum bicarbonate to normal as follows:

$$\text{mM} = \frac{(60 - \text{CO}_2) 0.7W}{2.24}$$

where mM=millimols of sodium bicarbonate or sodium lactate,

CO₂=carbon dioxide combining power in volumes percent, and

W=Weight of patient in kilograms.

One mM of sodium bicarbonate equals 0.084 gm.: One mM of sodium lactate is contained in 1 ccm. of molar sodium lactate (0.125 gm.). Lactate-Ringer's solution and interstitial salt solution are other commercial preparations that may be used if available.

General measures of treatment include the preservation of body heat, the use of cardiac and respiratory stimulants (caffeine, coramine, metrazol, camphor in oil, etc.) and adequate fluid intake. Because of its central depression, morphine or codeine should be used with caution. The fact that most deaths appear to follow respiratory failure suggests the use of resuscitation apparatus, carbogen, or the Drinker respirator, if available, as a final effort.

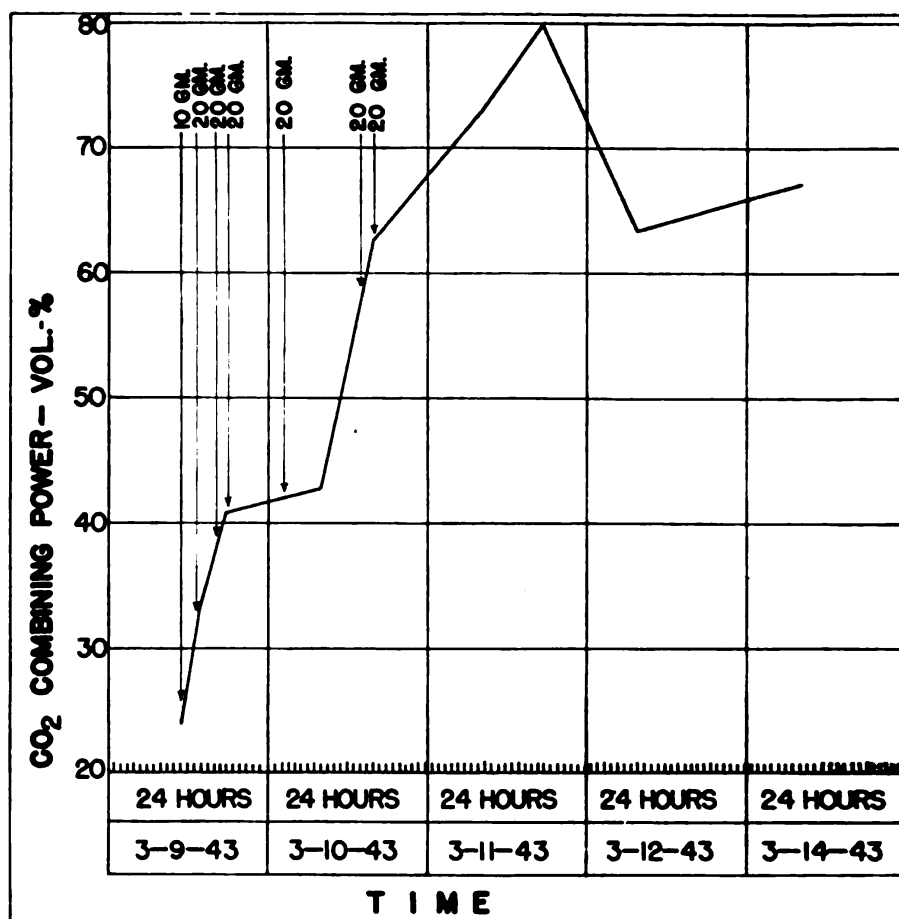
CASE REPORT

The patient was a 25-year-old torpedoman, third class, weighing 158 pounds. He was admitted 30 hours after the last imbibition of the methanol. An estimated 6 ounces had been ingested, but it was believed that some portion of this had been vomited during the evening. Upon awakening the morning of admission he noted a large central defect in his vision, although the peripheral visual

² Hartmann, A. F., and Senn, M. J. E.: Studies in metabolism of sodium *r*-lactate; response of human subjects with acidosis to intravenous injection of sodium *r*-lactate. *J. Clin. Investigation* 11: 337-344, March 1932.

fields were clear. Nausea, vomiting, and epigastric pain were present but not severe.

Physical examination was not remarkable. The conjunctivae were injected and the pupils moderately dilated and sluggish in reaction to light. The ocular fundi were negative except for slightly increased redness of the nerve heads. The vision was 10/20 in each eye, and newsprint could be read satisfactorily after momentary concentration. The circulatory system was apparently normal, the pulse being regular and full and the blood pressure 152/110. Reflexes, coordination, and speech were within normal limits. Cerebration was slow and deliberate, apparently requiring abnormal effort. The appearance and behavior of the patient did not suggest clinical alcoholic intoxication in spite of a blood



1. Showing the result obtained in the treatment of acidosis by intravenous sodium lactate.

ethanol value of 3 mg. per 100 cc. of blood. The urine was slightly positive for albumin but negative for acetone or other abnormalities. The erythrocyte count was 5,400,000, and the hemoglobin 116 percent. Blood urea nitrogen values were normal, and the carbon dioxide combining power of the blood was found to be 24 volumes percent, 12 hours after admission.

Because of nausea, the parenteral administration of sodium lactate was chosen for treating the acidosis. Dilution of the molar concentration of the drug was accomplished by adding the contents of 4 ampules (160 cc.) to 800 cc. of triple distilled water. While these preparations were being made it was observed that the patient was becoming less reactive, complained of increasing headache

and had vomited. In spite of continued adequacy of the circulation it was believed that the patient was rapidly losing ground and that coma was imminent.

From the equation mentioned it was calculated that 100 gm. of sodium lactate (800 cc. of molar solution) would be theoretically necessary to restore the serum bicarbonate to normal. The clinical response to this therapy was striking, the carbon dioxide combining power of the blood reaching normal in 24 hours. Figure 1 is a graphic representation of this reaction. A total of 130 gm. of sodium lactate was administered by intravenous route. It should be noted from figure 1 that administration of the last 40 gm. constituted an overdosage and resulted in alkalosis. This was due to the unavoidable delay in obtaining the value for the carbon dioxide combining power after the blood was withdrawn and an unwillingness to accept unreservedly the empiric value of the calculated dosage. As it happened the calculated dose would appear to have been the proper one.

It is of interest to note that the blood pressure which was moderately elevated on admission underwent a further rise during the course of therapy, attaining a peak of 196/112 on the second day. It subsequently returned to normal. The urea nitrogen fell to 6.5 mg. per 100 cc. of blood on the second day but was again normal on the seventh day. Whether this phenomenon represented a temporary failure of liver function is a matter for speculation. The icterus index was 5.0 and the hippuric acid test of liver function was normal on the eighth day. The blood chloride concentration was unaltered as was the total protein of the blood although there was some tendency toward inversion of the albumin-globulin ratio.

Convalescence was rapid and complete, the patient being discharged to duty on the fourteenth day of hospitalization with no residual effects of his illness apparent. The vision was 20/20 in each eye.

DISCUSSION

A single case report, particularly one terminating in complete recovery, fails to portray adequately the lethal potentiality of methyl alcohol when ingested as a beverage. While the exact details surrounding the decease of three of the individuals comprising the party are unavailable, it is known that two of them died within 24 hours without medical attention. The third reached a naval hospital but expired before diagnostic or therapeutic measures could be applied. The patient herein reported together with two others, who died before diagnosis or therapy could be accomplished, were observed at this hospital. The most striking feature of the latter two fatalities was the apparent satisfactory physical condition until coma suddenly supervened with convulsions followed shortly by death. The lack of symptoms or physical signs indicating the severity of the toxemia, the unfamiliarity of the problem to the medical officers in charge, and the absence of specific information in the available medical literature, all conspired to delay recognition of the desperate situation that presented itself.

It was said that the procurer of the liquor was observed in the act of filling a bottle from a 5-gallon can labeled "Methanol." This fur-

ther emphasizes the necessity for labeling this product "Wood Alcohol—Poison" instead of continuing the use of chemical or other terms confusing to the laity.

SUMMARY AND CONCLUSIONS

1. A synopsis of the symptoms and treatment of acute methyl alcohol poisoning, together with a case report is presented.
2. Acute methyl alcohol poisoning is accompanied by severe acidosis with few symptoms or physical signs suggesting the gravity of the process.
3. Prompt recognition and vigorous treatment of the acidosis is essential in minimizing fatalities.
4. In all instances methyl alcohol should be plainly labeled so as to indicate its poisonous properties.

FAVISM

REPORT OF A CASE

JOHN T. EADS

Lieutenant Commander (MC) U. S. N. R.
and

ROY M. KASH

Lieutenant, junior grade (MC) U. S. N.

Favism is a clinical syndrome caused by eating the beans or by inhalation of the pollen of the flowers of the *Vicia faba* (broad bean or horse bean). The clinical picture varies in severity from a mild acute gastro-intestinal upset to a very severe sudden attack of acute hemolytic anemia, hemoglobinuria, jaundice, and vascular collapse. It occurs frequently in Sardinia, in Sicily, and in some parts of the Italian mainland, particularly Calabria. Only two case reports (1) (2) have been found in American literature to date, although undoubtedly it must be encountered more frequently in this country, its entity unrecognized.

DESCRIPTION OF THE SYNDROME

Luisada (3) has written an excellent description of the favism syndrome and reviewed the literature. According to him it may occur at any age but most frequently in children and young adults of racial extraction indigenous to Sardinia and Sicily. There is a family predisposition to the disease. There is a definite seasonal prevalence, most of the cases appearing in the Spring during the months of April and May. Exposure as above causes the attack.

which are similar in their features regardless of which avenue of infection is responsible. Onset is within a few hours following the inhalation of the pollen. In the case of ingestion of the bean, 6 hours up to several days may precede the appearance of symptoms. The disease carries a mortality of 8 percent in Sardinia, mostly among the children and young adults affected (4). The most widely accepted theory as to the mechanism of the syndrome appears to be an acute allergic or anaphylactic shock. This has been shown by Pesci (5) in animal experimentation. An attack apparently desensitizes the patient for some time (several weeks to several months).

CLINICAL FEATURES

As mentioned before, the incubation period following inhalation of the pollen is only a matter of a few hours; following ingestion of the cooked bean (either fresh or dried) it may be from 1 to 2 days. The symptoms vary in severity; a mild form is quite common, resulting in nausea, vomiting, diarrhea, together with vertigo and weakness, and at times loss of consciousness, these symptoms usually disappearing in a few days. The more severe form is quite dramatic in its abrupt severe onset and its critical course. Death occurs in the fatal cases usually within a few days from a severe, rapidly produced anemia. Shock is one of the common features at the onset of the severe forms.

Differential diagnosis may be difficult. The various causes for an acute hemolytic process associated with jaundice, fever, hemoglobinuria, and hematuria must all be considered. The clinical picture is typical in the severe case. After desensitization a positive skin test may be obtained. Toxic agents accountable for the production of acute hemolysis must be ruled out. Malarial infections, particularly in the Mediterranean, often are concurrent. Specific infections such as Weil's disease and paroxysmal hemoglobinuria also must be differentiated. In this country particularly the diagnosis may not be easy. The chief point is in thinking of favism as a possibility, particularly if the patient is of Italian extraction.

CASE REPORT

History.—D. L., pvt., U. S. A., age 31 years, of Spanish-Jewish stock, was admitted to a United States naval hospital on May 12, 1943, with a provisional diagnosis of shock. He was home on leave and 3 days before admission to the hospital had experienced the onset of his illness. His first symptoms were generalized muscular aches and intense headache for the first day, followed the next day by several shaking chills, an elevation of temperature to 101° F., and the voiding of dark red-colored urine. He became nauseated and vomited several times on the second day. He was dizzy and felt very weak. On the third day jaundice appeared, his urine became darker, and the generalized body aches and weakness continued. He reported to a dispensary, while there collapsed and fainted, and was sent to the naval hospital by ambulance.

His past history was essentially negative except for an attack of jaundice 1 years previously which lasted only a few days, and two operations for a superficial rectal fissure in December 1942 and January 1943. No inoculations had been received for over 10 months. There had been no family history of jaundice, or of the ingestion of toxic drugs or agents, or any previous history of allergic manifestations.

Examination and clinical course.—On admission the patient was obviously acutely ill. He was perspiring freely, was quite dyspneic, and was somewhat disoriented. His lips and nail beds were cyanotic, and his skin was ashen gray. His sclerae were moderately jaundiced, and conjunctivae pale. He complained of being unable to breathe freely and of a sense of oppression in his chest. His temperature was 99.4° F., pulse 110, soft and regular. His blood pressure was 110/70. Respirations were rapid and shallow. Examination of his chest revealed many wheezes and musical râles throughout. No areas of consolidation were made out. His heart appeared normal in size. The heart sounds were somewhat faint but regular; no murmurs were heard. His liver was palpable two fingers below the costal edge and the edge was soft and tender. The gall bladder was palpable. The spleen could not be felt, although in the majority of cases it is palpable. A small superficial unhealed area was present in the perineum. His reflexes were normal. There was no edema and no petechial hemorrhagic areas were found. His skin was clammy and moist.

During the examination, he voided several ounces of a clear cherry-colored urine. He also had several loose watery stools within the first few hours.

On admission, his blood count was Hb. 9.5 gm.; R. B. C. 2,890,000; W. B. C. 19,000; differential smear—segments 51, bands 6, lymphocytes 36, eosinophils 4, and monocytes 3. Urine: Dark cherry color, albumin 4+, with strongly positive occult blood. Chest x-ray negative. Electrocardiogram tracing normal. Stools negative for ova and parasites; stool cultures negative. Blood smears, negative for malaria and leptospira; they showed stippled cells, anisocytosis, nucleated cells, and Howell-Jolly bodies. Urine negative for leptospira throughout. Blood culture negative. Blood urea nitrogen 16 mg. Prothrombin 88 percent normal; blood platelet count 95,446. Fragility R. B. C. normal. Icterus index 50.

Despite daily transfusions of 500 cc. whole citrated blood, the patient's blood count dropped to Hb. 7.0 gm., R. B. C. 2,020,000, and W. B. C. 3,000 on the fifth day of his hospitalization. The differential count and blood smear remained unchanged. The blood platelet count rose to 440,000 on the sixth day of hospital care, and his blood count began to show improvement. His urine was beginning to clear by the fifth day, and on the seventh day was normal. By the tenth day, the blood count had returned to normal and the patient felt well. The temperature ranged from 99.4° F. to 100° F. and terminated by lysis, reaching normal on the ninth day. The jaundice gradually cleared, and on the sixth day had disappeared, the icterus index being six on the sixth day. For 1 week, the patient was quite ill, complaining of muscular pains, extreme exhaustion, dyspnea, and headaches. He was able to tolerate a high protein and carbohydrate diet and was able to retain plenty of fluids, particularly fruit juices. His urinary output was excellent at all times. He remained pale and cyanotic, and the physical findings in his chest remained constant except for short intervals following the administration of epinephrine. His liver area remained tender to palpation for several weeks. At no time was the spleen palpable, and he continued to improve, though very weak.

About 1 month after the onset of his symptoms, he complained of discomfort in the upper right quadrant associated with slight nausea. This persisted for several days, then subsided. At this time a slight fever was also present. Biliary

tract studies were done which were negative. An intravenous urogram was also done which was negative. Blood counts and smears and urine examinations during this interval were normal. After several days these symptoms subsided, and the patient remained perfectly well.

Treatment.—During the acute admission phase epinephrine hypodermically was of value in controlling the dyspnea and sense of chest oppression, and combatting the vascular collapse.

Transfusions of whole blood were of the utmost importance. This patient had 3,000 cc. of whole blood during the first week of his illness.

500 cc. of blood plasma was also administered during the "shock phase."

5 percent dextrose intravenously was given freely the first few days.

Liver extract was used intramuscularly several times weekly.

Fruit juices and a high protein, high carbohydrate, low fat dietary regimen was instituted.

After the acute symptoms had subsided and the blood transfusions discontinued, large doses of iron were given.

COMMENT

The provisional diagnosis in this patient was acute hemolytic anemia with jaundice and hemoglobinuria, etiology obscure. Various possibilities were considered and efforts to determine the etiological factor were not successful. It was not until after several days of hospitalization that the history of ingestion of the beans was obtained. One of us (J. T. E.) had seen a previously reported case of favism, which experience was helpful in arriving at a diagnosis in this instance. The patient had eaten two meals of cooked beans on successive days prior to the onset of his symptoms, and had not eaten any for almost 2 years before, which fits the picture of sensitization well.

Six weeks after the onset of this illness, skin tests were made using a powdered extract of the beans. A positive scratch test was obtained in the patient, this consisting of a raised erythematous patch. Four controls were negative. The patient experienced some recurrence of body aches and malaise for about 48 hours following the skin test, but this promptly subsided without fever, and he again felt well.

CONCLUSION

Favism has been discussed, and the case history of a patient presenting the diagnostic criteria for this syndrome has been described.

From the literature this disease appears rarely to be recognized in this country; but it must occur frequently due to the large Mediterranean population now living in this country, to the cultivation of the *V. faba* in many sections of this country, and to the fact that for many years this bean has been a staple article of diet among the Italians.

The disease syndrome should also be of particular importance to the military forces engaged in activities in the Mediterranean area where

the disease is quite common, and where the bean is one of the main articles of diet. Exposure to the pollen or ingestion of the cooked beans may result in a severe widespread disabling illness among the armed forces.

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ATTENUATED TETANUS¹

A CASE REPORT

THEODORE A. FOX

Lieutenant (MC) U. S. N. R.

The drop in incidence of active tetanus in the armed forces speaks for the adequacy of tetanus toxoid immunization. That tetanus, however, may exist in an attenuated form after toxoid immunization and create a diagnostic quandary is illustrated in the following case report:

A 30-year-old soldier was admitted to the sick list complaining of a lesion on his right leg. He stated that 4 days previously he had "skinned" his shin while climbing out of a hatch and that at that time the abrasions were cleansed and tincture of merthiolate and dry dressings were applied. Examination, on admission, revealed a red and tender area on the anterior surface of the right leg. His temperature was 99.2° F., pulse 82, respiration 20. He improved under local treatment of hot wet dressings, with immobilization, and sulfathiazole orally.

The abrasions on his leg were healing when he developed a follicular tonsillitis on the tenth day after the injury. At 2000 that day, the patient complained of a severe headache, stiff neck, difficulty in swallowing and breathing, and severe pain in his back. His temperature was 103.4° F.

An examination revealed the following: The pupils were slightly irregular and unequal, and reacted sluggishly to light. A suspicious petechial hemorrhage was present in the left lower conjunctival sac. The pharynx was injected and hyperemic; as were the tonsils. There was marked rigidity of neck with strongly positive Kernig and Brudzinski. Musculature exhibited exquisite tenderness and hyperirritability, with the usual reflexes positive and hyperactive.

These findings led to the consideration of either meningitis; meningismus associated with sore throat (unusual in an adult); tetanus; or poliomyelitis.

The patient was isolated under strict communicable disease nursing technic.

¹ Received for publication March 24, 1943.

A spinal tap was performed, and the following results observed: Markedly increased pressure; bilaterally positive Queckenstedt; negative Pandy. The spinal fluid was clear, with five cells per chamber count. Smears of a centrifuged specimen were negative for organisms.

His white blood count was 12,700 with 68 percent neutrophils, 31 percent lymphocytes, and 1 percent monocytes. Other than for a few white blood cells detected on microscopic examination, the urinalysis was negative.

A 3,000 cc. intravenous infusion of 5 percent dextrose in saline was given to the patient, while sulfathiazole and thiamine hydrochloride and sodium amytal were empirically prescribed. The medications had to be crushed, due to the patient's dysphagia.

The next day the patient was more lethargic but his temperature had dropped to 100.2° F., and he seemed to be annoyed at the slightest disturbances. That evening he complained of difficulty in opening his mouth and of pain in his jaws. His temperature rose to 102° F., and he had marked trismus plus paresthesia, continued positive Kernig's and Brudzinski's signs, hyperesthesia, etc. Another spinal tap was done and the findings were essentially the same as before. The diagnosis was felt to be definitely established as an atypical, attenuated tetanus. (Such masking of tetanus was probably due to previous, recent immunizations with toxoid.) Immediately, 10,000 units of tetanus antitoxin was administered subcutaneously with 1,000 cc. 5 percent dextrose in saline, after skin and ophthalmic tests were negative for atopy. A smear of the wound, at this time, failed to reveal any spore-forming organisms, and no facilities were available for anaerobic cultures.

After the patient had received approximately half of the antitoxin, he became more alert. His headache, trismus, and the pain in the jaws subsided in a most dramatic fashion.

By the next morning his temperature was 99° F., and practically all his symptoms, including the trismus, stiff neck, positive Kernig's and Brudzinski's signs, and hyperesthesia, had disappeared.

The patient made an uneventful recovery and was discharged from the sick list 14 days after admission, or 18 days after the initial injury.

SUMMARY AND CONCLUSIONS

1. This case demonstrates that tetanus may exist in an avirulent form. The clinical test was made in administering tetanus antitoxin in adequate dosage, causing a complete and dramatic cure. This may not be uncommon in wartime, due to the widespread employment of tetanus toxoid immunization. Tetanus, although in an attenuated form, may occur in patients immunized with tetanus toxoid and should be looked for and treated with antitoxin as soon as the diagnosis is made.

2. The case also brings out forcibly that spore-forming organisms may be common contaminants of clothing—especially wool; this patient sustained his injury through the woolen trousers he was wearing.

MENINGOCOCCIC MENINGITIS¹

THOMAS M. MARSHALL

Lieutenant, junior grade (MC) U. S. N. R.

From a strictly military viewpoint, meningococcic meningitis is important mainly because of its depressing effect on the morale of both the officer and enlisted personnel. The occurrence of a few cases in a command arouses apprehension and fear, while a large number of cases of a less fatal and more common disease cause but little concern. During World War I, there were only 4,831 admissions to hospitals for meningococcic meningitis, but these cases caused 1,836 deaths—a case fatality rate of 38 percent. The disease ranked seventy-fifth as a cause of admission to hospitals, and sixth among the causes of death.

CASE REPORTS

C. J. S., seaman, second class, age 20 years, was admitted to the sickbay with the history of having awakened from a nightmare with a severe headache, sore throat, and a feeling of being "sore all over." Clinical examination revealed his temperature to be 102° F., pulse 80, and respiration 20. His face was flushed and his throat moderately inflamed. The deep and superficial reflexes were active and physiological, Kernig's and Brudzinski's signs were negative, and there was no rigidity of the neck muscles. While taking his temperature, however, he collapsed, but recovered from his apparent syncope almost immediately. He was put to bed and 2 gm. of sulfathiazole were given followed by 1 gm. 4 hours later. Eight hours after admission, corpsmen had difficulty in awakening him. He preferred to lie on his side with knees drawn up and head bent forward, plaintively resenting any disturbance. He responded in monosyllables with no modulation of voice or demonstration of expression and was apparently semicomatose. The pupils were widely dilated and equal, but reacted slowly to light. Respirations were deep and stertorous and the pulse was 68. The bladder was distended to the level of the umbilicus. There was no retraction of the head, but there was definite rigidity of the neck. Kernig and Brudzinski were now positive and all deep reflexes were hyperactive. A lumbar puncture at this time showed a normal spinal fluid pressure with "ground glass" fluid containing 415 polymorphonuclear cells per cubic millimeter. The Pandy test for globulin was 2 plus. A stained smear of the fluid showed an occasional gram-negative diplococcus and a culture of the fluid was reported as showing meningococci. On catheterization the urine was grossly bloody.

A Levine tube was passed into the stomach, due to the patient's comatose condition, and 4 gm. of sulfadiazine were given, followed by 2 gm. every 4 hours. There were no sodium salts of any of the sulfonamides available. During sulfadiazine medication, fluids were forced to well over 3,000 cc. daily by the tube and the urinary output was at least 1,500 cc. daily. Twenty-four hours after the onset, antimeningococcus serum was given intravenously—10,000 units administered every 4 hours until 100,000 units had been given. A mild serum reaction was noted following the first administration of serum, but no further reactions were seen with subsequent injections.

¹ Received for publication April 15, 1943.

On the second day of the disease the head was noticeably retracted and the face, neck, shoulders, and upper chest were covered with a diffuse petechial rash. A short time later large herpes developed on the left side of the mouth which was treated with 5 percent sulfanilamide ointment.

On the fourth day of the disease, the patient was rational, oriented, and able to take nourishment and medication orally. The herpes and petechial rash were clearing rapidly and the rigidity of the neck was becoming less marked. During sulfadiazine medication the temperature was not above 100° F., and the white blood count ranged between 7,000 and 9,000. On the eighth day sulfadiazine was discontinued. Several hours later the patient complained of intense itching over the body and a stiffness in his joints. His temperature was 102° F. and the white blood count was 16,500. A lumbar puncture at this time showed clear fluid, normal pressure, a cell count of 38, and a negative culture. Large urticarial wheals and areas of erythema soon developed over the entire body and the superficial lymph nodes became large and tender. The urinary output dropped to less than 500 cc. daily. Calamine lotion with 1 percent phenol and 0.5 cc. of 1:1,000 epinephrine subcutaneously were used as needed for the pruritus. The temperature remained elevated until the thirteenth day of the disease at which time it dropped to 98.6° F. and subsequently remained normal. The urinary output returned to normal and the superficial lymph nodes decreased in size. Convalescence was uneventful following this serum sickness and after numerous negative throat smears the patient was discharged 3 weeks from the onset of clinical symptoms.

A large number of Army personnel who had been released from cerebrospinal fever quarantine 1 day early, were embarked on this vessel 8 days prior to the onset of this case. They may possibly have been the source of the infection. No secondary cases developed among the Army personnel and no other cases have occurred in the crew.

THE TREATMENT OF GONORRHEAL OPHTHALMIA BY DIATHERMY IN CONJUNCTION WITH SULFONAMIDES¹

REPORT OF 3 CASES

FRANK P. SMART

Commander (MC) U. S. N. R.

CHARLES A. YOUNG

Commander (MC) U. S. N. R.

and

KENNETH PHILLIPS

Lieutenant Commander (MC) U. S. N. R.

The immediate effectiveness of general body fever produced by physical means in combination with the sulfonamides in the treatment of acute gonorrheal ophthalmia is no longer doubtful. Justifiable arguments against this procedure, however, are often raised on a basis

¹ Received for publication May 14, 1943.

of the special skill required for producing high and prolonged body temperatures with safety. The demand, therefore, for more conservative measures, providing they can reach the same effective range, is obvious.

Diathermy, either by long- or short-wave generators, suggests itself as a procedure worthy of investigation in the management of these infections. The risk involved, more especially with the conventional or long-wave diathermy, would be concerned with obtaining a sufficiently high temperature within the orbit without producing injury or burns to the eye itself.

Three cases have been treated and the results warrant a preliminary report of the method used. Some details are lacking in the first case, since the treatment was given empirically by the senior author approximately 15 years ago. In spite of conventional therapy at that time, it looked as though the eye would be lost, and sufficient data from memory of the case is presented as an aid to bolster up the possible value of the method.

CASE REPORTS

Case 1.—In 1927, a nurse, while on duty, received a splash in her eye during the process of emptying a bed pan. No notice was taken of the accident at the time, but after several hours 5 percent argyrol was instilled by the patient, as the eye began to smart. In about 36 hours a full-blown gonorrheal ophthalmia developed and conventional therapy of those days was instituted. The eye continued to grow worse and upon reaching the ophthalmologist (senior author) classical signs, including clouding and ulceration of the cornea, were present. The clinical impression was that the eye would be lost, and purely from a last resort viewpoint, diathermy (long wave) was administered locally to the eye for 30 minutes, at the highest intensity tolerable. Within 8 hours there was an improvement both clinically and symptomatically. The diathermy was repeated every 8 hours for three sessions. Recovery was complete with vision altered only to the extent of that caused by a small healed ulcer.

Case 2.—A seaman, second class, was admitted on February 12, with a fully developed gonorrheal ophthalmia, including positive smears, the result of accidental transplantation by contaminated hands. The orbital tissues were markedly swollen, with beefy red conjunctivae, severe blepharospasm, profuse purulent discharge, and beginning cloudiness of the cornea. He was started on sulfathiazole gr. 15, every 3 hours, during the 24-hour period, and given short-wave electromagnetic induction to the eye for 30 minutes. Within 6 hours following the first application there was notable improvement in the symptoms, the amount of swelling and spasm had decreased as well as the purulent discharge. Short-wave applications were continued for 30 minutes each 24 hours for seven treatments. Smears became permanently negative for gonococci at the end of 48 hours. At the end of the third day the sulfathiazole was stopped. Recovery was complete without alteration of vision, and the man was discharged to duty 12 days after admission.

Case 3.—On April 8, 1943, while en route to duty assignment, this patient, an aviation metalsmith, third class, awakened with swelling and severe pain and spasm in the eye. Upon arrival he was found to have an acute gonorrheal

ophthalmia with positive smears, whereupon he was transferred to the hospital. The eye was closed due to severe swelling and spasm; the cornea was cloudy and a profuse purulent discharge made the cul-de-sac difficult to clean. Within an hour after admission he was given 30 minutes' application to the eye with ultra-short-wave spaced condenser plates. Following this application, he was given sulfathiazole gr. 15, every 3 hours during the 24-hour period and frequent normal saline irrigations. Within 6 hours the pain and spasm had decreased until he could partially open the eye and the purulent discharge had reduced to only a small amount. The diathermy was not repeated; sulfathiazole was continued for 48 hours, then reduced to gr. 15, three times daily, for 2 days, and stopped. Smears became negative in 48 hours following the beginning of treatment. Recovery was complete with no alteration of vision, and the man discharged to duty on the eighteenth day.

DISCUSSION AND COMMENT

The superior efficacy of the combination of general body fever and chemotherapy over either alone in the treatment of gonorrheal infection, including that of the eyes, is no longer debatable. The problem, however, of elevating and maintaining a sufficiently high temperature within a single organ by the local application of these modalities, has been under considerable discussion.

One of the authors (K. P.) has contended during past years of experience with fever therapy, that temperature alone is not the sole factor in curing these infections; numerous cases have been cured with temperatures lower than the thermal death point of the organism. Other bodily immune factors, therefore, must be stimulated. Actual temperature readings of the cul-de-sac of the eye during the application, while of value, are not necessarily conclusive. Such readings were taken throughout a treatment with the following results: With the short-wave induction, the cul-de-sac temperature at the beginning was 97.2° F.; in 3 minutes, 103.8° F.; 5 minutes, 104.6° F.; 10 minutes, 106.2° F. With the ultra-short-wave condenser spaced plates, cul-de-sac temperature at the beginning was 96.2° F.; in 5 minutes, 102.4° F.; 10 minutes, 105.4° F.; 15 minutes, 106.4° F.; and in 30 minutes, 106.4° F.

The application of conventional or long-wave diathermy need not be discussed since it is not ordinarily included in Navy installations. Both the short wave ranging from 16 to 30 meters and the ultra-short wave from 6 to 10 meters wave length are used. Application of the short wave is best accomplished with either a small pancake coil or drum producing an electromagnetic field, while the ultra-short wave is conveniently applied with small circular condenser spaced disks.

While excellent clinical results were obtained with the above dosage, it is not likely that this minimal amount will be adequate in most cases. In case of necessity the application could be given with safety for 30 minutes every 3 hours during the 24-hour day.

The therapeutic part played by the diathermy is self-evident in that both symptomatic and clinical improvement took place before adequate amounts of sulfonamides had been given. However, the combination therapy is recommended for both speed and completeness of recovery.

Addendum.—Since the above article was sent in for publication, two additional cases have been treated with equally dramatic end results.

THROMBOSIS OF THE AXILLARY VEIN¹

REPORT OF 2 CASES WITH CLINICAL INVESTIGATIONS

MORTON D. WILLCUTTS

Captain (MC) U. S. N.

and

SAMUEL A. SHELBURNE

Lieutenant Commander (MC) U. S. N. R.

The clinical syndrome of primary thrombosis of the axillary vein was given widespread attention for the first time in a classical article by Rudolph Matas of New Orleans during 1934.² He reported a series of cases and called attention to the fact that it is often due to violent exertion, usually of the right arm in right handed individuals, and of the left arm in left handed individuals. He also noted that it sometimes appeared after slight exertion, such as swinging a golf club. He discussed in detail the theories and origin of this lesion. Recently this problem was reviewed thoroughly by DeBakey, Ochsner, and Smith,³ also of New Orleans. They call attention to the various forms of treatment, none of which have been highly successful. They mention the frequent failure of surgical interference and speak with some favor of the use of parasympathetic block with novocain.

The first case (S. J. W.) observed in this series is reported because of some interesting clinical investigative studies which were carried out in this hospital. The diagnosis in this case was not too clear, as he did not have any swelling of his arm when he appeared for observation, and it was only after the arm was vigorously exercised that cyanosis and swelling became apparent. A venous pressure determination was done, and this was found to be normal on both sides. However, he was asked to exercise both arms, and after exercise venous pressure was again determined. It was found to be normal

¹ Received for publication April 8, 1943.

² Matas, R.: On so-called primary thrombosis of axillary vein caused by strain: report of case with comments on diagnosis, pathogeny, and treatment of this lesion in its medico-legal relations. *Am. J. Surg.* 24: 642-666, June 1934.

³ DeBakey, M.; Ochsner, A.; and Smith, M. C.: Primary thrombosis of axillary vein. *New Orleans M. & S. J.* 95: 62-70, August 1942.

on the left (the unaffected side), but was 35 cm. on the right, and curiously enough remained at that level for 5 minutes, when it was thought wise to remove the needle from the vein. We were impressed with this technic as being an excellent method of judging progress in such a case; certainly it is desirable to be able to measure as accurately as possible any change in the clinical condition of such patients. We repeated these studies within 3 months of the original measurement, and were disappointed to find that there had been no improvement. The clinical signs were consistent with this finding. Venograms were also made which showed the obstruction in the right axillary vein. It was interesting to observe the results of determination of circulation time which was performed in each arm. Procholon was injected in the left arm, and the circulation time, arm to tongue, was 10 seconds, but there was no response on the right. Oscillometer readings on both arms were normal.

The second case (F. J. G.) was an epileptic who developed the signs and symptoms of thrombosis of the right axillary vein following a convulsion. We did not have the opportunity to study this patient as we did the other, but it is reported because a good response to parasympathetic block was obtained. An injection of novocain was made paravertebrally from the first to the fourth dorsal ganglia on the right as well as the stellate ganglion on that side. The swelling of the arm was relieved within a few days and it did not recur. A venogram made 2 weeks later was normal. It is impossible to state definitely that the good results from this injection were entirely due to the procedure, but it seemed to those who observed this patient that he had certainly improved rapidly very soon after this was done.

Several cases of primary thrombosis of the axillary vein have been informally reported as a result of jumping feet first from the deck of aircraft carriers in the early naval battles of this war. The men dropped feet first with their arms carried loosely. It has been emphasized before and should be repeated here that in jumping feet first from ships into water, the arms should be held straight and closely to the sides of the body.

Case 1.—S. J. W., a marine private was perfectly well until April 15, 1942, when while breaking concrete with a sledge hammer he first noticed swelling and weakness in the right arm. After throwing the sledge hammer over his back he had felt some pain in the right axilla, but had no further trouble until the following day. He stopped work for about 1 hour and the swelling subsided, but on resumption of his activity his arm again became swollen and he turned into the sickbay. He was treated for 2 weeks in the hospital, returned to his original station, and was assigned the duties of a truck driver, but he was unable to drive for more than 1 hour without developing swelling of the arm. He was in the embarrassing position of having to report to sickbay when nothing very obvious could be found wrong with his arm, for by the time he reached the doctor the swelling would have disappeared. The physicians who observed him were uncertain as to whether he had an organic lesion until it was shown that

swelling and cyanosis could be produced by exercise. While at rest his arm appeared perfectly normal, even in a dependent position, and the veins were not dilated more than the normal degree. After exercise the arm began to swell, being about 1 inch larger at the biceps than before exercise, and there was a dusky-red color of the entire arm. The veins were markedly dilated and remained so for 10 to 15 minutes following the exertion.

On October 1, 1942, the venous pressure readings were as follows:

<i>At rest</i>		<i>After exercise</i>	
Right arm-----	10 cm.	Right arm-----	37 cm.
Left arm-----	7 cm.	Left arm-----	9 cm.

The skin absorption time was normal; 0.1 cc. of normal saline injected intradermally disappeared in 50 seconds from both arms. Oscillometer readings were normal in both arms and both legs. Venograms (diodrast) made on October 3, 1942, of both arms showed marked dilatation of the axillary vein on the right, but not on the left. There appeared to be an obstruction above this dilated portion of the vein. On October 9 the circulation time using 20 percent prochlor was 10 seconds from the left arm to tongue, but no response was elicited when injected into the antecubital vein of the right arm. The venous pressure determination was repeated 1 week later and found to be 8 c.m. in both arms. We did not feel that he was a good candidate for paravertebral injections as he had no edema at rest. He was given a light detail and remained largely at rest until January 21, 1943, when all the studies listed above were repeated. His venous pressure was as follows:

<i>At rest</i>		<i>After exercise</i>	
Right arm-----	10 cm.	Right arm-----	37 cm.
Left arm-----	11 cm.	Left arm-----	10 cm.

The response to exercise was the same. There was no change in the venograms, and the studies of circulation time gave a similar response to that found in October. At this time 9 months had elapsed since his initial injury and no change had taken place, so it became necessary to discharge him from the service upon recommendation of a Board of Medical Survey. It is expected that another year will be required to restore his venous circulation completely.

Case 2.—F. J. G., an apprentice seaman, had been having attacks of epilepsy for 3 years. He was observed in an attack on October 25, 1942, and the next day swelling and numbness of the right arm appeared. He was treated with alternate elevation and dependence of the arm, 1 minute each for 20 minutes, thrice daily. The swelling persisted until November 21, 1942, when the first to the fourth dorsal ganglia as well as the stellate ganglion were injected. Two days later the swelling had largely subsided, and in another week he was apparently well. A venogram made on December 11 was perfectly normal. At this time his response to exercise of the arms was equal on both sides.

SUMMARY

Particular attention is called to the circulation studies made on Case 1—especially the determination of the venous pressure after exercise, which we think should be an excellent method of studying the clinical progress in cases of venous thrombosis of a low-grade type. If the patient has edema it is obvious that such studies are not necessary. The edema itself is sufficient index of improvement, but when the edema has disappeared and the venous pressure has returned to

normal, measurements of this sort should be very useful in following the progress of the disease. The circulation time studies are also of interest and are very simple to perform, and for this reason might be preferable to the venous pressure determinations before and after exercise. Venography is useful, but probably not as conclusive as the other studies. It should always be performed on both sides so that a comparison of the two sides can be made. One form of preferred treatment of this condition is exemplified in the report of the second case.

TREATMENT OF VINCENT'S ANGINA ¹

ARMIN T. FELLOWS

Lieutenant Commander (DC) U. S. N. R.

The following article must be classed as a preliminary report, based on observations for the past 9 months on some 36 cases. Vincent's infection, common to many military activities both ashore and afloat, sporadically has its outbreaks. My activity has had its share.

The following treatment with administration of neoarsphenamine and sulfathiazole consecutively has given excellent results.

TREATMENT

A case of Vincent's angina, diagnosed with or without the microscope, is given $\frac{1}{2}$ to 1 gm. of sulfathiazole orally thrice daily shortly after meals, with instructions for plenty of water to be taken. Envelopes containing the two succeeding doses of sulfathiazole, with time indicated when to be taken, are given patients. Sulfathiazole is continued for only 2 or 3 days depending on the severity of the case. One gram three times daily is given on 1 day, reducing to $\frac{1}{2}$ gm. three times daily 1 or 2 days following. Usually $\frac{1}{2}$ gm. doses for 2 days are sufficient.

The old established routine topical application of a saturated solution of neoarsphenamine in glycerin is next applied to lesions, these blown reasonably free of saliva. This should remain in contact with the gum tissue for about 1 minute, then the mouth emptied and lightly irrigated with warm water. This is washed around the mouth for 15 to 20 seconds, leaving a trace of the arsenate for prolonged effect. This topical application must be applied twice daily.

Sodium perborate in water should be used by patients after each meal and on retiring at night. Routine separate mess gear must be

¹ Received for publication April 8, 1943.

established for about 3 days. Then it is imperative that the toothbrush be well washed in running water and a "paste" of fresh sodium perborate applied and "allowed to dry on the brush," to prevent reinfection. This is continued daily for 5 to 7 days, when a new brush should be used. Smoking should be discontinued for a few days, substituting the chewing of gum if desired. Fresh fruit and raw leafy vegetables should be in the daily diet. In 48 hours, healed tissue commences to replace slough and gangrenous tissue. Microscopic slide tests disclose far less of Vincent's spirochete, and in 5 to 6 days are completely negative even in severe cases.

CASE REPORTS

Case 1.—A. P. K., a sergeant, U. S. M. C., reported with ulcerous pericoronitis in lower right third molar region with submaxillary and lymphatic gland involvement and fetid breath. Vincent's positive smear was found. The above treatment was instituted, 1 gm. three times daily the first day, $\frac{1}{2}$ gm. on the second and third days, with local application of neoarsphenamine. When the case was dismissed on the fifth day slides were negative. Glandular involvement disappeared on the second day.

Case 2.—G. S. D., a pharmacist's mate, second class, was hospitalized with streptococcal infection of the throat, followed 2 days later with sudden and severe gingival involvement. Smear was positive for Vincent's organisms. Heavy doses of sulfathiazole given for the throat infection did not prevent the Vincent's infection. Neoarsphenamine applied locally, however, brought the case under prompt control. Because of the previous administration of sulfathiazole, it was not given.

Case 3.—E. M. S., a private, first class, U. S. M. C., had a gingival involvement of the left tonsillar area. One-half gram of sulfathiazole thrice daily for 3 days and local application of neoarsphenamine to the affected area for 5 days cleared the infection promptly.

Case 4.—G. J. F., a seaman, second class. Routine treatment with sulfathiazole and neoarsphenamine was administered to this case which cleared in 4 days.

Case 5.—G. S., a seaman, first class, had gingival involvement of the lower anterior gums. Routine treatment was given and the case dismissed 3 days later as cured. Mapharsen was used in this case.

Numerous simple gingival involvements, seemingly not requiring sulfathiazole and treated only with neoarsphenamine, dragged out for 5 or 6 days with positive slides. These responded promptly when sulfathiazole was administered. Mapharsen, when used instead of neoarsphenamine, gave satisfactory results. On completion of Vincent's treatment a thorough scaling and cleaning should be instituted.

The question of incompatibility of the sulfa drug and its associate arsenate may arise. I have been advised by the head of the department of pharmacology of one of our large medical schools that seemingly these drugs are compatible. It must be considered that only a small trace of neoarsphenamine or mapharsen would be swallowed in ordinary treatment.

My conclusion is that the arsenate and sulfathiazole are synergistic in action, since the former is a spirocheticide and the latter not, but when combined they work toward a positive cure.

Cases with anemic tendency should have medical approval in instituting this treatment.

Addendum.—With the same technic, supplanting the arsenate in the above article with 10 percent chromic acid, and reducing the sulfathiazole to 1 gm. at initial sitting, followed by ½ gm. 4 hours later, preferably after meals, generally gives a negative Vincent's slide in 48 hours. No failures have resulted in five months.

A SIMPLIFIED ROUTINE FOR THE TREATMENT OF ACNE VULGARIS¹

JOSEPH M. SHELTON
Lieutenant (MC) U. S. N. R.

At this station each man is given a mimeographed copy of the following instructions:

INSTRUCTIONS FOR ACNE PATIENTS

Your skin condition is not serious but, if not attended to, may persist for years and leave many unsightly scars. We suggest that you follow these instructions as carefully as possible.

Diet.—Avoid the following foods as much as possible. (Complete avoidance may be impossible since you must eat at the general mess.)

Chocolate—all forms, including chocolate candy, cake, icing, ice cream, cocoa, etc.

Nuts—including peanut butter.

Greasy and fatty foods.

Pastries.

Sweets and sweet drinks (Coca-Cola, etc.).

Milk. Do not drink large quantities.

Skin cure.—Wash face with warm water, plain toilet soap and a wash cloth at least two times daily. Rinse with cool water. If your skin is very oily, it is a good plan to work up a thick lather on your face and let it dry on the skin before washing it off.

At bedtime apply the skin lotion by shaking the bottle, spreading the lotion on the face and patting it into the skin firmly. Let it dry and remain on the face during the night. Wash the lotion off in the morning. This lotion will probably make your skin somewhat dry and scaly. This is to be expected.

General instructions:

Drink plenty of water—6 to 8 glasses daily.

Keep your bowels open.

Avoid the use of all ointments and creams. It is better for you to use a brush and lather for shaving rather than one of the brushless shave creams.

Be patient. It requires considerable time to produce any marked improvement in a chronic skin condition such as you have.

¹ Received for publication January 25, 1943.

We employ one of two lotions as a night application. For the common type of papulopustular acne 3 percent precipitated sulfur in calamine lotion is used:

℞ :	
Precipitated sulfur.....	4 gm.
Calamine.....	} aa 12 gm.
Zinc oxide.....	
Glycerin.....	6 cc.
Lime water qs. ad.....	120 cc.

In the superficial pustular type of acne it has been found better to substitute 5 gm. of sulfanilamide or sulfathiazole for the sulfur.

In addition to the above measures, increasing doses of cold quartz ultraviolet irradiation have been given at 4-day intervals. The first dose is usually 4 minutes at 12 inches distance. This is increased with each subsequent exposure, the maximum dose not exceeding 10 minutes to any one area. Sufficient irradiation should be given to produce a moderate erythema and desquamation. If the combined use of the lotion and ultraviolet produce too much drying, the use of the lotion is temporarily suspended.

It may be necessary in some cases to open and drain large lesions and to incise and express comedones.

Many acne sufferers feel that very little can be done for them, so it is a pleasure to note that the favorable results obtained by our relatively simple measures have apparently prompted a constantly increasing number of men to apply for treatment.



ERRATUM.—In the September BULLETIN,
page 1491, line 1 of formula 2 should
have read:

“Mercuric oxycyanide—0.1 gm.”

MEDICAL AND SURGICAL DEVICES

A TECHNIC FOR INTRODUCING THE MILLER- ABBOTT TUBE ¹

WENDELL H. HAMRICK
Lieutenant (MC) U. S. N. R.

The value of the Miller-Abbott tube in relieving abdominal distention from any cause has been firmly established. In the years since Miller and Abbott devised it for studies of the physiology and chemistry of various levels of the intestinal tract, many indications for its use in surgery have been found—and some contraindications.

The contraindications are such only in the sense that delay in certain conditions must not be hazarded while awaiting passage of the tube. Bowel circulatory accidents such as strangulation from hernia, volvulus, mesenteric thrombosis or any cause are considered the main contraindications. It is seen that the contraindication in these conditions is not to the use of the tube, but to the delay often entailed in passing the tube.

Delay, then, is contraindicated, but it does not follow that the introduction of the tube is also contraindicated. Sound surgical judgment cannot be displaced by any number of gadgets that may come into use. The Miller-Abbott tube is to be utilized as a valuable adjunct in the surgeon's armamentarium of treatment and diagnosis. Its use does not, and must not, commit the surgeon to one unchangeable course of treatment. As a matter of fact, its use requires of the surgeon even more alertness for changing symptomatology.

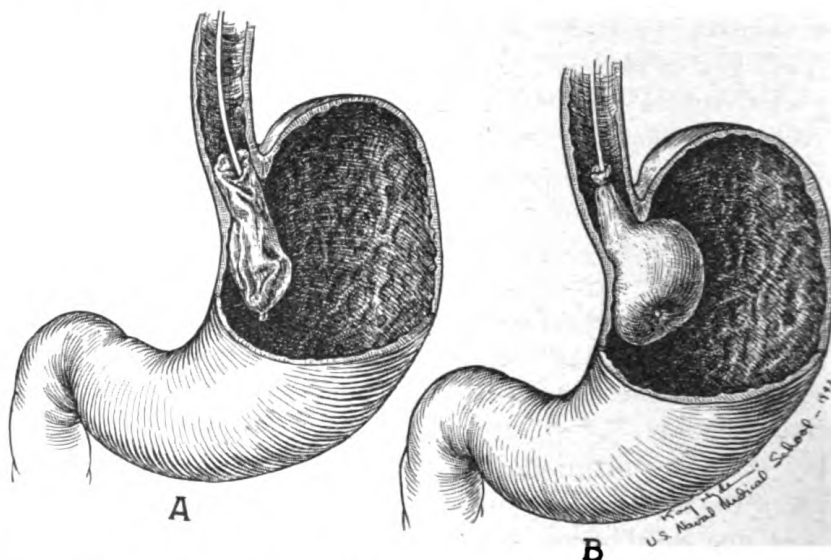
Given a case of strangulated inguinal hernia, reasonably proved by history, x-ray and physical findings; the tube can be introduced, the stomach washed out, the operation performed, and the tube then advanced to act as Wangensteen duodenal suction. Some form of suction is almost invariably indicated postoperatively in such cases. If full-blown paralytic ileus develops, the balloon may be inflated and allowed to carry the tube the length of the small bowel, progressively and rapidly relieving the distention and permitting early return of peristalsis.

It can safely be said that when duodenal suction is indicated for distention, whether preoperative, postoperative, or nonoperative as in

¹ Received for publication May 26, 1943.

the ileus of vertebral fractures, the Miller-Abbott tube is as easy and as certain of introduction into the duodenum as the shorter tubes. It is more efficient than many shorter tubes in that it will aspirate both stomach and duodenum simultaneously, and give the added advantage that it can be advanced as indicated.

Recent articles in the *BULLETIN* mentioned the use of the tube in cases of intra-abdominal injury to survivors, sustained through underwater explosions of depth charges and aerial bombs. It might not be amiss to review a technic for its passage which does not depend entirely on the x-ray guidance. The method is not original with this writer, but is taken from Abbott's original descriptions, plus some very sound



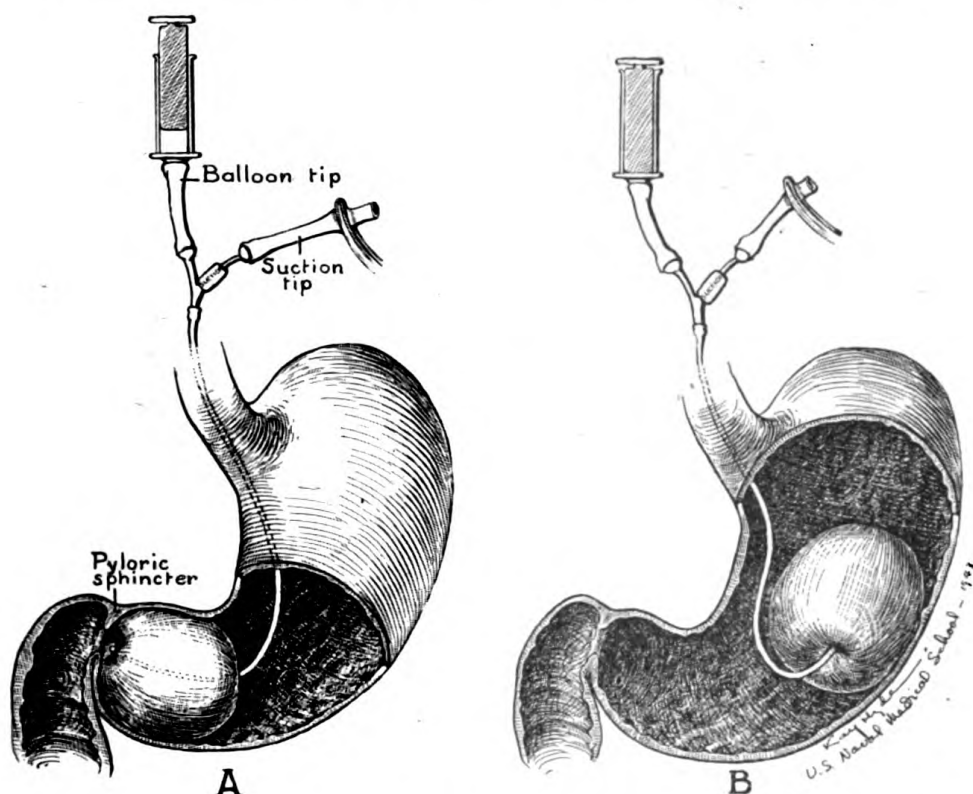
1. Stomach has been thoroughly lavaged and emptied. Balloon is inflated and tube withdrawn until balloon hangs at cardia, after which balloon is deflated, patient is turned on right side, and with 250 cc. of air in stomach, tube is advanced 5 inches.

suggestions by Jonathan Rhoads of the University of Pennsylvania Graduate School of Medicine.

A slim Rehffuss-type bucket tip replaces the one furnished by the manufacturer. If this special bucket is not available, a standard tip can be filed down satisfactorily to a diameter of about 8 mm. This permits easy introduction through the nasal passages. If no Rehffuss tip is available, the manufacturer's tip may be weighted by solder or brazing.

The balloon and suction outlet are carefully tested for patency and airtight integrity. The entire method is explained to the patient. The nasal space and pharynx may or may not be treated with pontocaine or cocaine and ephedrine spray or swab. The lubricated tip is passed through the nostril to the stomach as with any other tube (fig. 1A).

Thorough gastric lavage with warm saline is then done, the patient being allowed to see the green-blue stomach washings. This sight often makes a much more cooperative subject by the early visual evidence of what to him is the cause of the nausea and vomiting. In a cooperative patient with a very full stomach, much tedious syringing may be avoided by connecting suction to the suction tip, and having the patient drink 500 cc. of water or normal saline over a period of



2A. Peristalsis of pylorus forces air out of balloon, causing rapid and forceful ejection of syringe plunger.

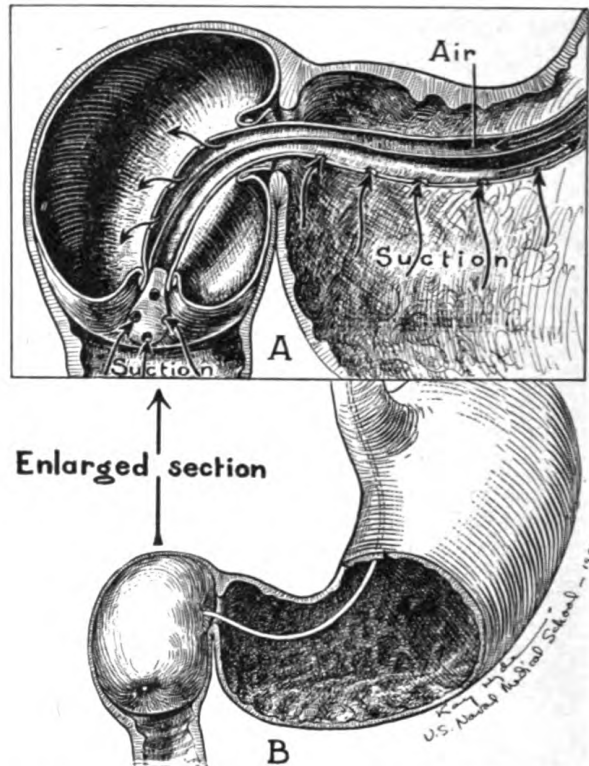
2B. If tip has turned away from pylorus and into fundus of stomach, no peristalsis will be noted, and no movement of syringe plunger. Tube must then be withdrawn to cardiac end and the entire maneuver repeated.

30 minutes. He is usually encouraged to find he does not vomit the water as he had been doing.

After complete emptying and cleaning of the stomach, 250 cc. of air is syringed in through the "suction" tip, and retained by clamping. The patient is turned to his right side, the balloon is inflated with 30 cc. of air, and the tube withdrawn until it hangs by the balloon at the cardia (fig. 1B), thus giving a landmark. With the patient continuously on his right side, the balloon is deflated and the tube is advanced slowly 1 inch every 2 minutes during deep breathing by the patient until 5 inches have been advanced. The 250 cc. of air

is for the purpose of partially separating the mucosal walls of the stomach for more certain gravity guidance of the heavy tip, the right side position making the pylorus the lowermost point of stomach.

Small sips of ice water are allowed. The patient is given morphine if the procedure has proved an ordeal, and is left alone for 1 to 2 hours, being careful that the balloon is deflated, and that suction is not on. After this 1- to 2-hour wait, the tip is usually at the pyloric sphincter,



3A. Showing detail of tip and double lumen of tube.

3B. Tip beyond sphincter, duodenal peristalsis on balloon will cause halting, weaker rhythmic ejection of syringe plunger. If x-ray is not available, this rhythmic plunger action, together with the aspiration of bile, is sufficient. Patient may then be turned on back, balloon inflated, suction applied to "suction" tip, and tube advanced 2 inches every 20 or 30 minutes, usually by the patient.

and sometimes already beyond the sphincter. A free running 30-cc. syringe can be used to test its location if the distention is not extreme. Thirty cubic centimeters of air is injected by syringe into the balloon, the syringe being kept connected. If the balloon is in the pyloric antrum, the syringe plunger will be strongly forced back by the peristaltic action of the pylorus on the balloon (fig. 2A). If lying in the fundus of the stomach, no back pressure will be noted except in extreme distention, and then usually in rhythm with the respiration. If the tip and balloon have already passed into the duodenum, the

plunger action will be delayed, weaker, and rhythmic, peristalsis being noted every 30 to 90 seconds, and of a halting type.

If the plunger test indicates that the tip is at the pylorus or in the duodenum, the tube is advanced 2 inches and the patient is again left for 1 hour on the right side. If persistent injection and withdrawal of air into the balloon causes no movement of the plunger, the tip is almost certainly in the fundus of the stomach, usually directed away from the pylorus (fig. 2B). In this case the tube must be withdrawn to the cardia and the entire process repeated.

One hour after the 2-inch advance of the tube, the syringe is applied to the "suction" tip and aspiration is attempted. If clear yellow bile is recovered, the tip is usually well into the duodenum (fig. 3B). At this stage the first x-ray is helpful. A portable or mobile unit without Bucky is sufficient. If the x-ray is not available, the surgeon may fairly well assure himself that the tip is in the duodenum by sitting beside the bed and trying the plunger test for 10 minutes. In inflating the balloon with 30 cc. of air, considerable back pressure is exerted and the plunger will be noted to remain stationary for some time. It then will often descend in the syringe of its own weight as the duodenum relaxes, this process being repeated every few minutes. With such a clear-cut plunger test, taking care that the rhythm is not that of the respiration, the surgeon does not need the x-ray, but may with confidence inflate the balloon, clamp it off securely, introduce suction to the "suction" tip, and advance the tube 2 inches every 20 minutes. The balloon should be checked every 2 or 3 hours to be sure the air has not leaked out.

In refractory cases, the patient may be allowed to rest 3 or 4 hours or even overnight, with suction on and water allowed by mouth. Much gas and dark bile will be regurgitated into the stomach after the original emptying of the stomach, and while the tube is a temporary failure it will often be found to have relieved a considerable part of the distention while still in the stomach. This is very frequently the fate of the short tube duodenal suction decompression method.

If, after a third attempt, success is not obtained, the balloon may be inflated with 20 cc. of water and directed toward the pylorus as previously described; this may give the pylorus and sphincter a more natural grasp of the balloon.

The busy surgeon will rarely have time to follow each patient through every step of this procedure; but if he is to add this very valuable adjunct to his armamentarium, he must devote hours to the first two or three cases in order that he may direct an attendant adequately in future cases. With an intelligent attendant, the surgeon's visits can be materially reduced.

It is noted that the terms "suction" tip and "balloon" tip are frequently used in the above description. Many failures have occurred because the attendant did not have a clear picture of the design of the tube. It is difficult to retain a clear picture without having seen at least one end of the tube with the tip removed, so that the thin partition making the double lumen can be demonstrated (fig. 3A). Leaky balloons can be replaced with a product usually supplied by the venereal disease control officer, this product serving as well as the manufacturer's more expensive balloon.

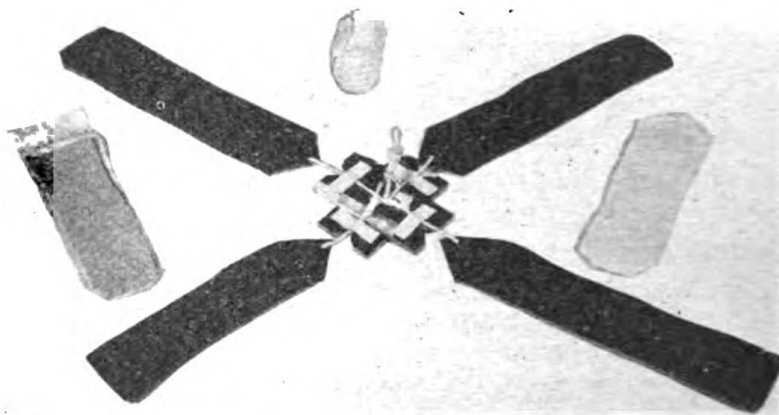
The overnight improvement in a desperate postoperative ileus case following successful introduction of the Miller-Abbott tube should be reward enough for any reasonable number of hours spent in perfecting the technic of its use.

RUBBER-SURFACE SKIN TRACTION FOR RETRACTING AMPUTATION STUMPS¹

HAMILTON I. BARNARD

Lieutenant Commander (MC) U. S. N. R.

In certain stumps, especially those following the guillotine amputation, the skin and underlying soft tissues retract, forming a pain-

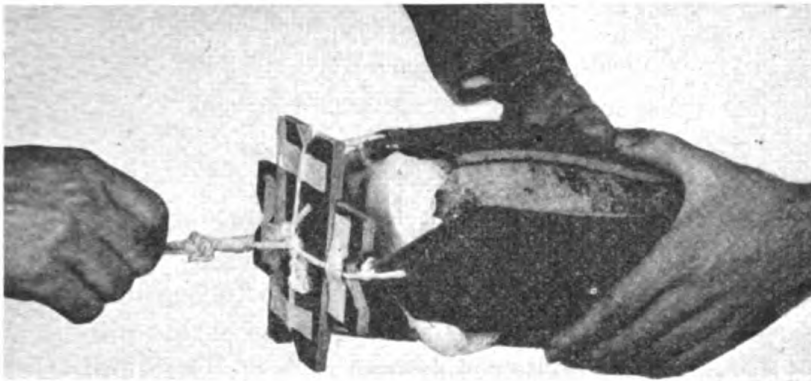


1. Four strips of foam rubber $\frac{3}{8}$ -inch thick, 3 inches wide, and about 6 inches long (only two shown); canvas strips the same width and 2 inches longer; a cross-type spreader with cord attached; 3-inch elastic roller bandage.

ful, adherent scar over the end of the bone. Some form of skin traction applied early following the amputation, is a helpful preventive, and also promotes more rapid healing of the wound. Adhesive tape, though generally used, is quite unsatisfactory because of the discomfort on removing, the irritation of the skin, and the constant slipping.

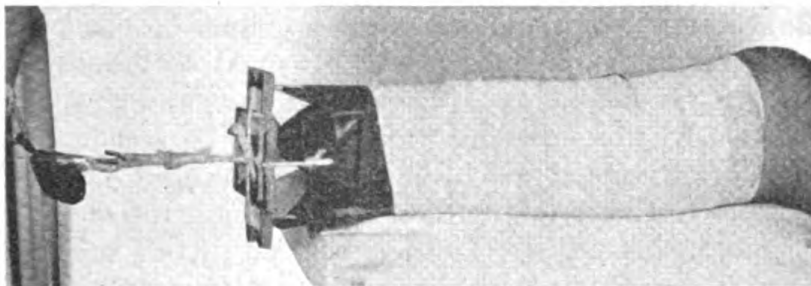
¹ Received for publication May 7, 1943.

The following described traction will avert many of these objections to adhesive tape, and will give, in addition, more rapid shrinking of the soft tissues, thereby permitting the early application of the prosthetic appliance. The materials used are similar to those used as described in a previous article.² Details are shown in figure 1.



2. Rubber and canvas strips shown being held by assistant, ready for application of elastic bandage.

A canvas strip is affixed to each rubber strip with rubber cement. A piece of cord about 6 inches long is then fastened to the overlapping canvas, and the four string ends are fastened at right angles to the spreader. The skin is shaved, tincture of benzoin compound is applied, and the strips are then laid longitudinally and parallel to the stump as shown in figure 2. The patient or nurse holds the strips



3. Traction in position with weights applied.

as the elastic bandage is rolled on snugly. A slight pull on the spreader is made so as to equalize the pressure. The rope is then attached to the spreader, run through the pulley on the bed, and weights are attached as shown in figure 3. (Five-pound weights are usually ample.)

The rubber traction can be removed daily without discomfort, there is no irritation of the skin, and the tissues are compressed.

² Barnard, H. I.: Rubber-surface skin traction. *J. Bone & Joint Surg.* 24: 462-463. April 1942.

PREVENTION OF AERO-OTITIS MEDIA ¹

USE OF DIFFERENTIAL PRESSURE AT SIMULATED HIGH ALTITUDES IN LOW PRESSURE CHAMBER

JOHN B. MacGREGOR

Lieutenant Commander (MC) U. S. N.

OTIS J. FRONEK

Lieutenant Commander (MC) U. S. N.

and

FRANCIS G. DOYLE

Ensign A-V (S) U. S. N. R.

Considerable difficulty has been caused by aero-otitis media during indoctrination runs in the low pressure chamber. Though careful physical examinations are made to eliminate individuals with acute upper respiratory infection, this complication continues to occur with sufficient frequency to be a troublesome factor. Originally this complication was treated by local applications of vasoconstrictor agents and self-produced increased nasopharyngeal pressure. This procedure was slow and oftentimes ineffectual in producing relief.

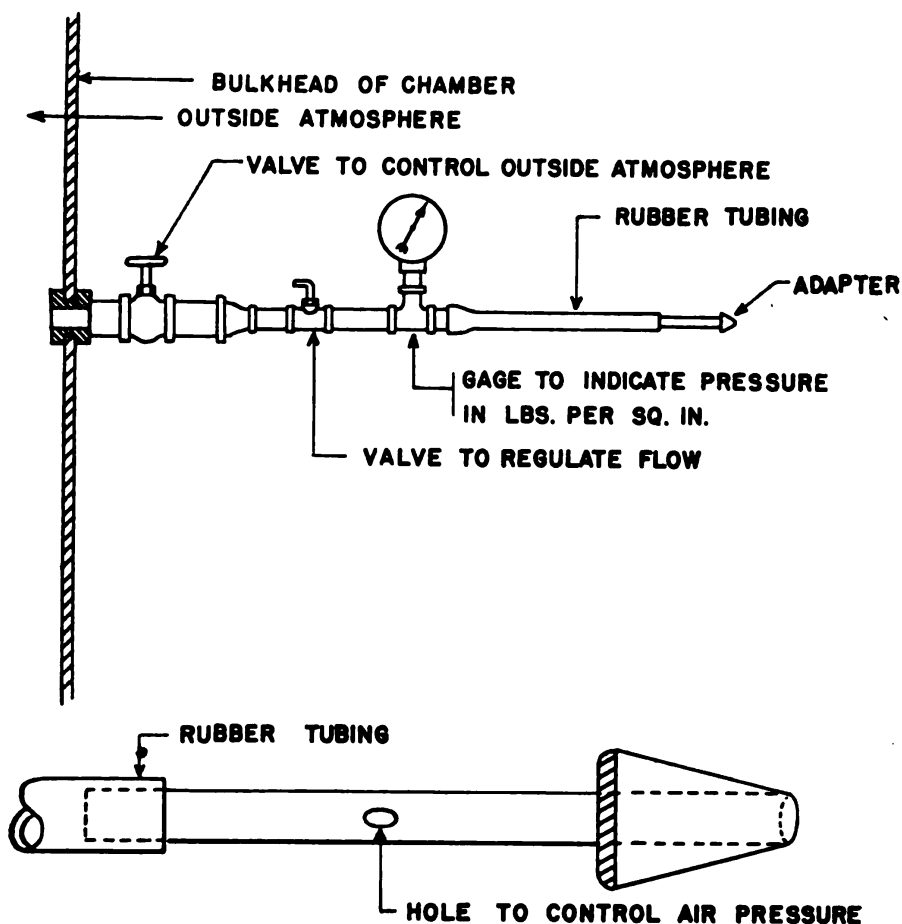
It was apparent that some mechanical inflation was necessary to relieve the pain and hasten the continuance of a normal run. The electrically powered compression apparatus was ruled out because of the spark factor in the presence of open oxygen; consequently, an apparatus was rigged for the utilization of differential pressure. This was accomplished by connecting a reducing valve and gage to a valve leading from the outside of the tank, the reducing valve being necessary since the differential pressure between the tank and the outside atmosphere would exceed the safe limit of 3 lb. per square inch. A hand valve which is placed proximal to the compression gage makes it possible to obtain the desired pressure by metering the flow. Obviously, this metering process has to be accomplished for the particular altitude at which the tank is leveled off. To the gage outlet a 1/4-inch rubber tubing of sufficient length to reach all seats in the chamber is attached. To the other end of this rubber tubing is attached a metal tube with a flanged nasal adapter. The metal tube containing the nasal adapter has a small hole drilled in it which makes it possible for the operator to regulate the pressure digitally (covering the hole to apply pressure in the nose or uncovering it to permit escape of air and reduce the pressure within the nose).

The following procedure is used for patients in distress with aero-otitis media:

The patient is instructed to take a mouthful of water and retain it until told to swallow. The operator then introduces the nasal adapter into the nostril.

¹ Received for publication April 19, 1943.

With the free hand the operator occludes the other nostril. Then with the finger of the hand holding the nasal adapter, the operator closes off the hole in the tube, forcing air into the nose. The patient is then instructed to swallow the water, thus releasing the eustachian sphincter, which permits the passage of air into the



ADAPTER DETAILS

DIAGRAMMATIC SKETCH OF APPARATUS FOR UTILIZING POSITIVE PRESSURE IN CASES OF EUSTACHIAN TUBE BLOCKAGE AT HIGH ALTITUDE

middle ears and inflates the space, giving immediate relief. On return to sea level the ears are re-examined and the patient is referred to the EENT department for observation and further treatment, if necessary.

The use of a hand atomizer with aqueous solution of a vasoconstrictor substance was so slow in acting, and otherwise indefinite in accomplishing results, that when the above-described apparatus was installed the use of the old-type atomizer was discontinued. Experiments are being conducted toward the perfection of an atomizer utilizing the pressure obtained with this new apparatus.

AN IMPROVISED FIELD METHOD OF MANAGEMENT OF FUNGUS INFECTIONS OF THE FEET

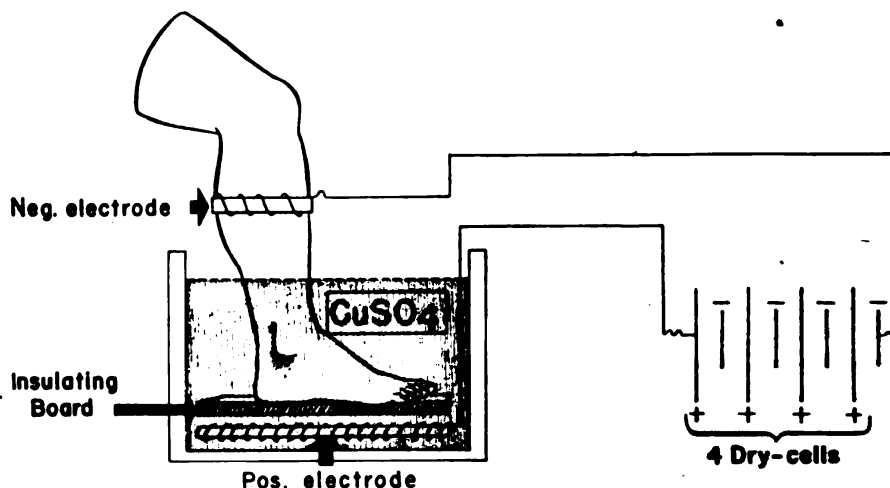
STUART C. KNOX

Lieutenant (MC) U. S. N. R.

Fungus infection of the feet is an important cause of disability among troops serving in tropical areas. In this battalion numerous cases which failed to respond satisfactorily to the usual and available therapeutic measures were encountered. It was necessary to hospitalize many of these patients, and several were incapacitated for further duty.

Copper ionization had previously been used by the author in such cases with satisfactory results. It seemed advisable to improvise a method for applying this therapy with materials available in the field.

Such a device was assembled, and the results in the first 2 months indicated that this technic may prove superior to the usual methods of field therapy in fungus infections of the feet. Several cases which had recurred after previous hospitalization were satisfactorily controlled after three to five applications of the ionization technic. Other cases which presented ulcerated areas of long standing healed rapidly after copper ionization was instituted. During this preliminary period it has not been found necessary to admit any patients for hospitalization because of fungus infections.



The method is simple and requires the following materials:

1. One foot bath of nonconducting material. A suitable receptacle was improvised by lining a wooden box with 2 layers of surveyed tenting canvas. The dimensions of the box, 16 inches long by 12 inches wide by 12 inches deep, is sufficient to permit immersion of the foot and lower portion of the leg.
2. Four dry cells of $1\frac{1}{2}$ volts each, connected in series.
3. One copper electrode. A satisfactory electrode was improvised by coiling copper wire around a sponge-rubber core. This was placed in the bottom of the

foot bath and insulated against direct contact with the skin of the foot by means of a thin board inserted into the foot bath directly over the electrode. This electrode should be connected to the positive pole of the series of batteries.

4. One indifferent electrode. This is to be connected to the negative pole of the series of batteries. For this electrode a band of sponge-rubber was used as a core and it, also, was wound with bare copper wire. This electrode is separated from the skin by a wrapping of gauze moistened with saline solution. The electrode is applied around the extremity, below the knee and at a line approximately 2 inches above the level of the copper sulfate solution in the foot bath. It may be held in position by bandages or by a snap fastening device which was utilized in our equipment. For efficiency, good contact between this electrode and the saline gauze wrapping should be maintained.

5. Two lengths of insulated copper wire to connect the electrodes to the battery terminals. If a clip connecting device is available it saves time in applying the treatment.

6. Copper sulfate crystals to make a 0.2 percent solution. Weak solutions ionize more satisfactorily than stronger solutions and the above-mentioned strength has proved efficient.

The average duration of each treatment was 6 minutes. Mild cases responded following one or two treatments. Severe cases were given as many as eight treatments, usually on alternate days. All cases should be given a 2-minute test treatment to eliminate the possibility of copper sensitivity in the individual. This is relatively rare, and reasonable care in observing the treatment of these cases should eliminate the occurrence of such reactions. No cases in the present series experienced any untoward results.

Approximately 100 treatments were given with each group of 4 dry-cell batteries. The cells were then replaced by new ones. The effective life of the dry cells is questionable and as no milliammeter was available for use in the circuit it was considered advisable to proceed empirically.

The apparatus could be improved by the use of a milliammeter and a rheostat. This would permit a more accurate control of the dosage. However, the method as described here appears to be effective. The lack of more refined appliances has produced no discomfort to the patients; the only sensation being an instantaneous slight muscular reaction on making or breaking the circuit and a very mild sensation of warmth during the treatment.

One case of fungus infection of the hands was satisfactorily treated by the same method. Other areas of the body could be treated by using the same principle; a gauze pad moistened with the 0.2-percent copper sulfate solution being placed over the affected area and placed in contact with a positive electrode of suitable size and shape.

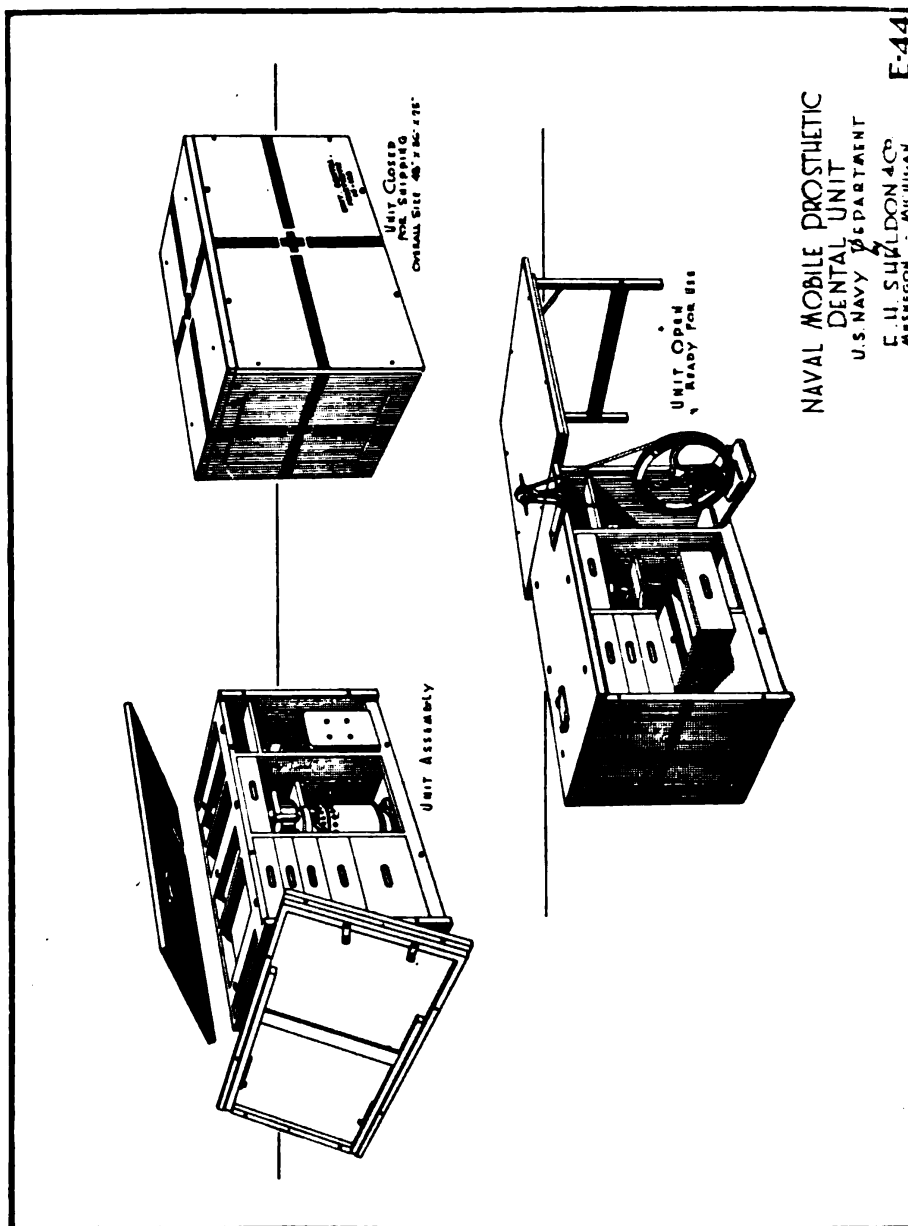
Sheet copper, if available, could be utilized instead of the copper wire coils. If a coil is used there should be enough coils to give a surface area of copper of at least 6 square inches for treating a surface as large as the foot.

NAVAL MOBILE PROSTHETIC DENTAL UNIT

CLIFFORD E. ALLEN

Commander (DC) U. S. N.

The tempo of the present war, the distance to the theaters of operations, the type of modern warfare used, has necessitated the develop-



ment and adoption of a complete self-contained portable prosthetic dental laboratory unit for use on ships and in the field.

The Bureau has approved and accepted a portable design that can be used in base hospitals, mobile hospitals, mobile dispensaries, ad-

vance base dispensaries, in the field with the Marines, and in activities of other shore establishments.

This unit can be easily transported by plane, ship, or truck, and assembled for use in a very short time. If the operator desires, he can arrange the unit in several positions to fit the space allotted. Only a small amount of room is required when fully assembled, occupying an area of 20 square feet. Compactness is the keynote of the unit for utility and transporting.

The case when packed for shipment or transportation will occupy 24 cubic feet of space. Its weight is 475 pounds, packed with all equipment and supplies for a 3-month period. It can be readily taken through compartment doors and passageways of ships or planes.

In packing, the enclosing case has been made watertight. Where no docks or piers are available for landing cargo, the case can be launched overboard and floated ashore or towed to the beach by small boats.

The unit is complete within itself, having all the necessary equipment and supplies needed. For activities, where no electricity will be furnished, or the working load becomes too heavy for the generators to provide electricity for use of the dental lathe, a foot-power lathe has also been installed.

When the front of the box is removed for assembly of the unit, this part is set up as an additional workbench, is fastened to the end of the case by cleats, and is supported on the opposite end by folding legs. This provides an additional workbench of 12 square feet, accessible from 3 sides. The casting machine, vulcanizer, flask press, polishing motor (dental lathe), splash pan, foot-power lathe, and Coleman stove are assembled and secured on top of the case proper, the top of which is removed and turned over to receive this equipment. This top furnishes a working area of 8 square feet freely accessible from 3 sides and is covered with a water and fire resistant, as well as a highly chemical resistant composition material.

Chucks for the electric dental lathe are interchangeable with the lathe powered by the foot wheel, thereby utilizing the same grinding stones, polishing wheels, etc. The foot wheel and lathe are of a similar pattern to those used by jewelers, small instrument repairmen, diamond and stone cutters, and dentists before the era of the electric motor.

Mounting of the foot wheel is accomplished by fastening its base to a wood pedestal, which is bolted to hinges on the front center bottom part of the cupboard that receives the wheel when tipped into place for storage, or out for use. The foot-power lathe is mounted on top of the case in a jig that projects slightly beyond the table top, thereby placing it in a free position to receive the drive belt from the foot-power drive wheel below.

The exterior cabinet frame is of heavy solid birch, with all corner joints bolt-reinforced. All panels are of resinous bonded birch veneer. The removable top and side are of solid sheets of impregnated wood fiber. The unit has six drawers of various sizes. Each drawer has a slide cover which prevents sticking. Each drawer is provided with several removable partitions, which allow for compact storage of the supplies.

Two cupboards are provided. These have been particularly designed for stowing the larger pieces of equipment such as the vulcanizer, gasoline generator, pails, etc. Straps are secured within the cupboards at proper places for fastening the equipment when the unit is transported.

It is intended that the cabinet top when reversed and secured will be the principal place for work. The cabinet front, when set up as a substantial folding table adjacent to the end of the cabinet, is primarily for placing materials and equipment not in immediate use. However, it provides a large area, and incidental work to the principal operations can be done here.

The cabinet, except for incidental hardware, is furnished without the use of critical materials. Metal drawer pulls have been eliminated, drawer grips have been machine routed out of the drawer fronts.

The Coleman gasoline lantern is supplied as an emergency light in case of power failure, and in activities without electrical service. The Castle emergency spotlight No. 30 is provided for activities with electricity. The Castle light is mounted in the battery box in the base. Batteries are self-charging.

A DEVICE FOR REDUCTION OF CONTACT EXPOSURE IN SICKBAYS AFLOAT¹

CLIFFORD P. McCULLOUGH

Commander (MC) U. S. N. R.

It has been a recognized fact that a considerable number of cases of infection of the upper respiratory tract develop in hospital corpsmen and patients already hospitalized in sickbays afloat, due to contact exposure of droplet infection. This is most pronounced when cases of tonsillitis, bronchitis, streptococcus sore throat, or virus pneumonia are admitted to the sickbay and insufficient space is available for isolation.

The infectious organisms liberated by coughing or sneezing are easily carried to other patients in adjacent bunks, and are a menace to

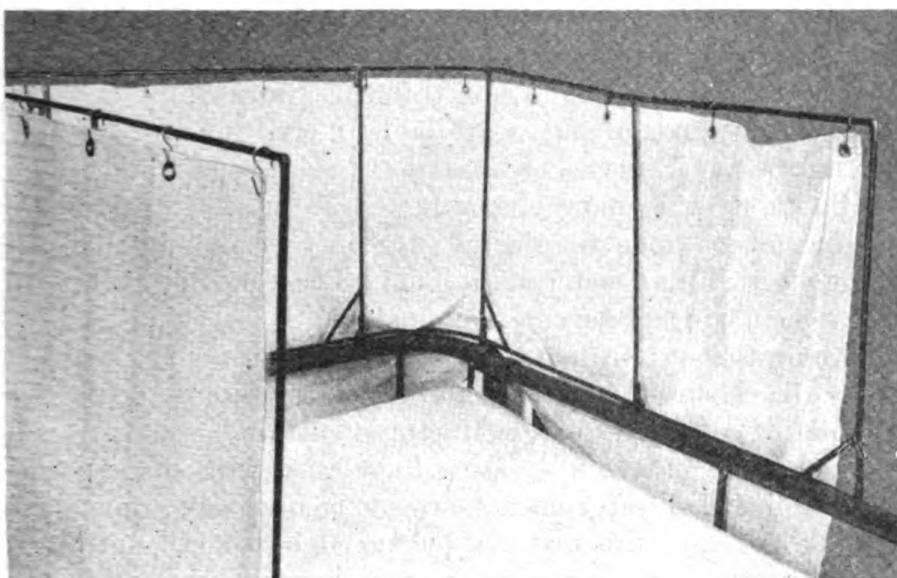
¹ Received for publication May 14, 1943

those whose resistance is lowered because of present illness or injury. This condition not only creates a medical hazard, but is a detriment to the effective use of manpower aboard ship.

In a study made aboard this ship to minimize the number of cross infections, a device was evolved which served admirably for this purpose, and which fulfills the necessary requirements for a sickbay afloat. These requirements are:

1. Ease in handling.
2. Secured to the bunk to withstand heavy weather or rough handling from patients or attendants.
3. Provides easy accessibility for treatment.
4. Of sufficient size to prevent spread of infection by coughing or sneezing, but not so bulky as to obstruct passageways or cause difficulty in stowing.
5. So constructed that the patient does not have a sensation of oppression or restraint.

The photograph² shows that all requirements are fulfilled in this device. It is light in weight, easily handled by one man, and is se-



1. Sneeze curtain installed in sickbay.

cured firmly to the top rail of the bunk by means of spring clips (the struts between the top and bottom frame retain the frame in position under all conditions). The muslin cover, with rings pressed into the top, is attached to the top of the frame by means of hooks which are adjustable, and can be quickly attached or detached; the bottom of the cover is not fastened and allows the attendant easy access to the patient for medication, temperature readings, etc. The frame extends below the midline of the chest when the patient is supine, but does not interfere with easy access to, or exit from, the bunk, and does not cause the sensation of being shut in, which is feared by so many

² Detailed line drawings may be procured from the author.

patients. When not in use, at least two of the frames may be secured to an empty bunk, facilitating stowage.

The device has proved very beneficial in reducing cross infection in our sickbay, and is submitted with the hope that it may be of value to others with limited facilities for isolation.

THE RESTORATION OF INCISAL CORNERS WITH AMALGAM¹

CHARLES R. PHINNEY

Lieutenant, junior grade (DC) U. S. N. R.

A problem frequently encountered in the naval dental practice is the restoration of the fractured incisal corner in upper central and lateral incisor teeth. These breakages usually result from the previous placing of silicate cements on the proximal surfaces of these teeth without due regard to the undermining of the fragile enamel corner. Less frequently they are seen following traumatic injuries.

The usual methods of repair available in civil practice are not employed in the naval service because of the relative cost and time consumed in fabricating more elaborate restorations. It, therefore, becomes incumbent upon the dental surgeon to make suitable repairs with the plastic filling materials at hand. These include oxyphosphate of zinc cement, silicate cement, and amalgam.

The limitations of ordinary oxyphosphate cements are well understood by all. Their use in making these repairs is limited to the temporary relief of sensitivity of the fractured surface.

I have had no success in treating these cases with silicate cements. The durability of silicate cements seems to be inversely proportional to their bulk. Because this material has no edge strength, such restorations are particularly vulnerable to the shearing stresses which are developed by the anterior teeth. It is my opinion that silicate cements have no place in the treatment of these fractured corners.

I have had considerable success, however, in the use of amalgam for these fillings. The description of the technic used logically resolves itself into three phases: Cavity preparation, the insertion of the amalgam, and the final finishing.

TECHNIC

Cavity preparation.—The initial step includes the removal of all the remaining silicate cement from the previous preparation. Attention

¹ Received for publication May 14, 1943.

is then drawn to the labial margin of the cavity. This margin is planed back with carborundum or sandpaper disks. The cut is made as nearly parallel to the long axis of the tooth as possible. The proper placing of this cut is important for esthetic reasons. If this margin is straight as well as in the line of the axis, the finished filling will be found to be in considerable harmony with the surrounding tooth surfaces. It is desirable that the enamel of the finishing line be well supported by sound dentine. If, however, this entails too drastic cutting of the labial surface, some compromise may be effected by packing tooth-colored oxyphosphate cement under the unsupported enamel. As with any type of amalgam filling, it is unwise to pack amalgam under unsupported enamel. Internal pressures created by the expansion of the amalgam will undoubtedly result in further fracture of the enamel.

A lingual lock, analogous to that which would be cut for the typical anterior inlay preparation, is then prepared. This lock is cut with fissure and inverted cone burs, and is placed to take advantage of the heavier structure of the cingulum. It is well to remember that the strength of the finished filling will be proportional to its bulk and therefore a large, well-placed lock is to be desired in preference to a small one. Small undercuts are then placed in the floor of the lock, using No. 35 inverted cone burs. The gingival floor is then straightened and made horizontal with hand instruments. Where possible, a small undercut is made in the dentine of the gingival floor, running the entire length of the step. If the depth of the preparation arouses fear for the safety of the pulp, a small amount of loose cement is flowed over the axial wall of the cavity, and molded to the desired contour while still plastic.

Insertion of filling.—The proper placing of the amalgam entails the construction of a matrix which will afford the maximum visibility into the cavity, while at the same time giving the filling the necessary contour. A block of compound made from a small piece of tracing stick is carefully warmed in the flame, and is used to make a labial index of the surface of the tooth in question, as well as the labial surfaces of the adjacent teeth. After chilling with water, it is removed from the mouth. Some of the compound will have entered the cavity preparation through the labial cut. This excess is removed with a small knife or a cleoid, and the desired labial contour is carved into the index. The index may be placed back upon the teeth, and viewed from the lingual aspect to see whether sufficient compound has been removed to impart the desired shape to the labial surface of the finished filling.

A piece of steel matrix material is then selected and shaped so that it roughly restores the missing contour of the tooth. It should be high enough so that, while amply covering the incisal edge, the

gingival end extends at least 1 mm. below the preparation. The matrix is given a gentle bend so that it will fall naturally against the tooth when compressed by the compound. A small plastic or wooden wedge is selected, and is placed below the gingival margin with the steel matrix in place. The protruding end of the wedge, which is placed from the labial inward, is then cut off with a bur. This is done so that it will not impede the seating of the compound block. The compound block is carried carefully into place and compressed with the thumb against the steel matrix and the underlying tooth. Visual inspection from the lingual aspect will show the steel matrix to have taken the desired form. Constant pressure is maintained against the compound block while the amalgam is being inserted into the cavity from the lingual side. When the amalgam has assumed the initial set, the compound block can be safely removed. At least 20 minutes should be allowed for the hardening of the amalgam before attempting to remove the steel matrix. After the remainder of the wedge has been removed, the matrix is carefully teased out in a labio-incisal direction.

Finishing of the filling.—After the matrix has been removed, rough carving is accomplished with the use of the cleoid. It is, of course, vitally important that the incisal edge of the amalgam be trimmed so that it will not stand alone in either the centric or excursive relationships of the arches. Final carving is accomplished with finishing burs for the internal aspect and fine sandpaper disks for the labial surface.

This is followed by the bristle brush and pumice. The bristle brush is recommended over the rubber cup, because continued use of a small cup will generate sufficient heat to bring some of the mercury of the amalgam to the surface. This will lead to pitting and discoloration of the finished surface. A final brilliance can be achieved with whiting. I believe that a mirrorlike finish is to be desired, because such polishing seems better to conceal the finished filling.

CONCLUSION

Ordinary care in following the above outlined procedure will invariably result in a pleasing filling which will give infinitely better service than a similar restoration made of silicate cement. The broad purpose—namely, to preserve the teeth in a state of health and function, will have been eminently satisfied.

We in the service will have the satisfaction of knowing that our simple technic will have preserved these teeth in comfort and health against the day when these men return to civilian life where other more esthetic means can be used to restore them.

EDITORIALS

LARGE DOSES OF MORPHINE

In spite of warnings regarding the dangers of overdosage and the requirement of suitable markers indicating use—the availability, ease of administration, and high potency of morphine Syrettes constitute a real inherent hazard.

Against pain and extreme physical discomfort, morphine surpasses all other analgetics in efficiency, particularly in the persistent and exhausting pain of trauma. Its action dulls, however, rather than abolishes pain, and renders the patient indifferent or detached from the discomfort and fag.

Quantitative measurements of the pain threshold in man show that the analgetic effect of morphine increases markedly with the dose up to 10 mg. ($\frac{1}{6}$ gr.). Above 15 mg. ($\frac{1}{4}$ gr.) little increase in effectiveness is observed. Doses larger than 15 mg. introduce undesirable factors.

There may be a fall in body temperature as much as 2° C. below normal, particularly if the individual is kept in cold surroundings. The depressant effect on respiration enjoins caution. Doses which diminish the sensitivity of the respiratory center increase the carbon dioxide content of the plasma and produce asphyxial acidosis, with marked and rapid decrease of the alkali reserve and of the pH of the blood. Administration of large doses in lung pathology or with severe hemorrhage becomes hazardous for the same reasons.

Morphine should be avoided in nervous disorders and psychic excitement; battle casualties with such complications have adverse factors operating against large doses of morphine.

It is not a somnifacient, and should not be given to control hysteria or produce sleep.

It must be remembered that young individuals are more susceptible to the side effects of morphine than are adults.

Recent reports from battle areas reveal that not infrequently the half-grain dose produces nausea and vomiting, a not uncommon complication and a particularly distressing one under combat conditions.

The hyperactivity of the injured in battle or major catastrophe may be attributable to other causes than pain. The role fear, hysteria, or cerebral anoxia play in the writhings and uncontrolled activities

of patients was demonstrated in the Boston fire. Morphine, whatever the size of dose, is unwise in these cases.

The sedative action of some other drug might be utilized and prove synergistically beneficial in conjunction with a reduced dosage of morphine.

THE PROBLEM OF PEPTIC ULCER

British and Canadian medical writers recently have stressed the seriousness of the peptic ulcer problem in the armed forces. The statistics bear a remarkable similarity to our own—digestive diseases accounting for a large percentage of all medical patients admitted to military hospitals.

Logan¹ claims that if all the peptic ulcer patients of the Navy in 1940 had been concentrated in one hospital, a ward of 47 beds would have been occupied continuously throughout the year.

More recent reports show that a total of approximately 125,000 sick days were recorded for some 2,000 admissions with the diagnosis of ulcer.

That peptic ulcer is on the increase is shown by the fact that in 1924 the admission rate for this disease was only 69 per 100,000, while today it has more than doubled this figure.

Much speculation as to the cause of such increase has been put forth. Doubtless many remember the peak rise of this affliction among civilians during the days of the depression. One wonders just what part anxiety, fear, and uncertainty play as causative agents.

The high incidence of ulcer in troops evacuated from France in the early part of the war lends credence to the support of these factors as contributory causes. Furthermore, a similar rise was seen in civilians under present wartime strain. During the period of intense bombing of Bristol² the number of cases admitted to the hospital with perforated peptic ulcer increased by 15 percent over the number of similar cases admitted in times of peace.

The disposition of these patients in military medicine is a recognized medical problem. Some^{3,4,5} advocate that the man with peptic ulcer is unfit for military service and should be invalidated immediately, and returned to civilian life in the shortest possible time.

¹ Logan, V. W., and Bransford, P. W.: Peptic ulcer in the U. S. Navy. *Ann. Int. Med.* 18: 929, June 1943.

² Wolley, C. J. P.: An analysis of gastric and duodenal ulcers in the Vancouver General Hospital. *Canad. M. A. J.* 49: 113, 1943.

³ Chamberlin, D. T.: Peptic ulcer and irritable colon in the Army. *Am. J. Digest. Dis.* 9: 245-248, August 1942.

⁴ Smellie, J. M.: Gastric disorders in army. *Lancet* 1: 322, March 14, 1942.

⁵ Urquhart, R. W. I.; Singleton, A. C.; and Feasby, W. R.: Peptic ulcer problem. *Canad. M. A. J.* 45: 391-395, November 1941.

On the other hand under proper conditions, others⁶ feel that the ulcer victims are capable of performing valuable and important tasks, occasionally such as would entail serious loss without their services.

Elsewhere in this *BULLETIN*, Walters and Butt (p. 1679) discuss the problem of disposition from the aspect of treatment. These authors believe that each case should be evaluated individually, considering among other things the duration and severity of the ulcer symptoms and whether a reasonable response can be expected from medical or surgical treatment.

It is interesting to note that among the figures quoted above, roughly one-third of the number of admissions were invalidated, another third returned to duty, and the last third remained under continued treatment. Whether the third returned to duty represents too high a figure, only time and circumstances will disclose.

The enormous number of sick days and the likelihood of relapse under the stress of war of the healed case, make the most hopeful wary of the value for military service of a truly diagnosed peptic ulcer patient.

AIR-BORNE INFECTIONS

Pandemic influenza is a possibility¹ for the coming year. Whether the dreaded specter will appear and reap its world-wide harvest, remains, of course, locked among the secrets of the future.

Assuredly there is nothing we can do to prevent it, at least nothing that preventive medicine thus far has put forth.²

Discovery of certain drugs has made us expectant, though skepticism is fully justified by the disappointing limitations and failures of these same drugs.

Certainly we entered the current world conflict less concerned over the menace of air-borne infection. Whether our trust has been well placed remains to be seen. These infections appear not to threaten the health and well-being of our troops as they did during the previous World War. What has brought about this change is speculative.

The control of epidemic respiratory disease in peacetime may have made appreciable advance, but in time of war the close aggregation of individuals leaves it still a challenge to preventive medicine.

⁶ Palmer, W. L.: Stomach and military service. *J. A. M. A.* 119: 1155-1159, August 8, 1942.

¹ Francis, T., Jr.: National conference on post-war planning. *Science News Letter* 43: 185, March 20, 1943.

² Siegel, M.; Muckenfuss, R. S.; Schaeffer, M.; Wilcox, H. L.; and Leider, A. G.: A study in active immunization against epidemic influenza and pneumococcus pneumonia at Letchworth Village: IV. Results in an epidemic of influenza A in 1940-41. *Am. J. Hyg.* 35: 186-230, Jan.-May 1942.

Complete protection against transferral of infection by air is improbable. What part air conditioning, aerosols, ventilation, and ultraviolet radiation play in this regard is difficult to say, as local factors enter so materially. Incidence is probably more a measure of susceptibility than of exposure. The reservoir is not the polluted air but rather the mucous membrane of the nasopharyngeal passage.³

Whether invasion occurs or not depends upon the integrity of this structure and the mucous blanket that covers it. Organisms enmeshed in this sticky outer covering are expelled by ciliary action. Damage to this protection, whether by infection or by climatic change, permits accumulation of microorganisms and body entrance, throwing a demand upon the general antibody mechanism of the body. Artificial immunization⁴ as applied to the respiratory diseases is still experimental and discouraging.

Turning to chemotherapeutic control, however, the July issue of the *BULLETIN*^{5,6,7} discussed the incidence of 189 cases of cerebrospinal meningitis with the remarkable record of only 4 deaths, and the prompt suppression of scarlet fever outbreaks by the timely administration of sulfonamides has recently been reported. These are encouraging examples of chemotherapy, offset by the experience accumulating in the literature accentuating the ineffectiveness of the newer drugs as specific agents against many air-borne infections. Their use is indicated in the control of secondary complications, particularly acute otitis media, bronchitis, and bronchopneumonia.

The present state of mechanical, immunologic, and therapeutic advance implies a hope that medicine is equipped better than ever before to cope with air-borne infections of pandemic magnitude.

³ O'Hara, D.: *Air-Borne Infections*. E. L. Hildreth & Co., Inc., 1943.

⁴ Stokes, J., Jr., and Henle, W.: *Studies on methods of prevention of epidemic influenza*. *J. A. M. A.* 120: 16-20, September 5, 1942.

⁵ Taranto, M.: 100 consecutive cases of cerebrospinal fever at Camp Endicott. *U. S. Nav. Med. Bull.* 41: 961-965, July 1943.

⁶ Newcomer, W., and Frame, E. M.: A summary of 50 cases of cerebrospinal fever, meningococcic. *U. S. Nav. Med. Bull.* 41: 966-972, July 1943.

⁷ Van Orden, T. D., and Armentrout, C. H.: Treatment of cerebrospinal fever, meningococcic. *U. S. Nav. Med. Bull.* 41: 973-976, July 1943.

BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

GERIATRIC MEDICINE, Diagnosis and Management of Disease in the Aging and in the Aged, edited by *Edward J. Stieglitz, M. S., M. D., F. A. C. P., Consultant in Gerontology, National Institute of Health; Visiting Physician, Medical Service, Baltimore City Hospitals.* 887 pages; illustrated. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$10.

This is the kind of book that should be provided the general practitioner of the future.

The curse of undergraduate medical education of the present day is the tendency of the superior student to emphasize the specialty he has chosen; and to minimize the importance of the other specialties; thereby failing to gain that broad outlook on the whole field of medicine, which made an Osler. Osler's early professorship in the institutes of medicine at McGill University (Physiology and Pathology in its application to practical medicine) might well be introduced again for those entering the teaching of internal medicine. Fifty years ago, our superior general practitioners evolved into professors and consultants in the various fields of specialism, and many of them kept up their general practice—Agnew, at the time of retirement, continued to be consulted as family physician by his former patients.

While Osler, 50 years ago, could write on all subjects covered in a practice of medicine, this is today unsatisfactory, in view of the encyclopedic information required for such a book. That which makes Cecil's Practice of Medicine so popular is that each monograph is written by an authority on that subject. The same is true of "Geriatric Medicine". Three of these monographs have been prepared by the editor—"Orientation," "Principles of Geriatrics," and "Hypertensive Arterial Disease and Hypotension." The first two will satisfy the sociologist and statistician—the third, the superior general practitioner in search of practical as well as scientific information on this truly important problem.

The editor has stressed the importance of "preventive geriatrics" and has insisted on opportunities for treatment of the "aging" rather than the "aged." He gives as the critical years the two decades from 40 to 60. I am glad to note the emphasis on avoidance of competitive sports for the aging. This agrees with the views of the father of tropical medicine, Sir Patrick Manson, who stressed the dangers for those living in the tropics, of exercises involving rivalry—the emotional factor blocks Nature's warnings. The common-sense recommendations of Dr. Stieglitz as to diet, exercise, and drug treatment should be carefully read by those attending aging and aged patients. Doctor Sebrell has written a chapter on nutritional problems in the aging, which I consider exceptional for its conciseness and scientific accuracy. He stresses the importance of vitamin deficiencies in old people, whether from faddism, lack of appetite, or lack of assimilation. It is in the older patient we must suspect deficiencies in the B complex. I am glad to note Sebrell's emphasis on the encephalopathic type of acute niacin deficiency, even in the absence of suggestive manifestations of pellagrous eruptions.

It would be discriminatory to make selections for review from these almost 50 monographs, but anyone reading the qualifications and teaching positions of the contributors, pages IV–IX, must be convinced that an authority on the subject has been chosen.

All medical men bow to the work of the great cardiologist, Sir James Mackenzie, and yet few know of his sacrificing his consultant practice to take up the work which seemed to him the solution of preventive medicine—the recognition of the earliest deviations from normal functioning of the body. He even suggested that the most experienced mind operate in the out-patient service, leaving the junior physician in the ward to do what little can be done for the advanced degenerative disease.

He spent the last few years of his life at the St. Andrews Institute for Clinical Research, where he had for his staff the general practitioners of St. Andrews, Fife, and for his consultants, the faculty of the University, St. Andrews. Mackenzie's views are outlined in the first report of the St. Andrews Institute for Clinical Research, 1922.

In pathological histology we stress the comparison of the information obtained by low-power magnification with that gotten from the high-dry or oil-immersion objective—the coordination of these facts makes for more satisfactory diagnosis.

So, likewise is the man who loves detail—the "exact" mind—which considers unity rather than multiple diversities.

There are many minds among superior general practitioners where coordination appeals rather than minute details.

The coordinating mind can utilize the minute observation of the specialist and arrive at a diagnosis. So this book furnishes the authoritative and detailed facts from many fields or consultants, and there are many minds among family physicians fitted for coordination of such facts.

GOUT, by John H. Talbott, M. D., Associate in Medicine, Harvard University; Assistant Physician, Massachusetts General Hospital, Boston, Mass.; edited by Henry A. Christian, A.M., M.D., LL.D., Sc.D. (Hon.), F.A.C.P., Hon. F.R.C.P. (Can.), Hersey Professor of the Theory and Practice of Physic, Emeritus, Harvard University. 55 pages; illustrated. (Reprinted from Oxford Loose-Leaf Medicine with the same page numbers as in that work). Oxford University Press, New York, publishers, 1943. Price \$2.50.

It might seem that an era of enforced nutritional deficiencies, of widespread food rationing, would see a reduction or elimination of gout. The old "port-wine", high-living theory, is a die-hard. "Many of the gouty patients in our series have been admitted in an impoverished or indigent state, * * * rarely did we obtain a history of repeated overindulgence in rich foods and alcoholic beverages."

This small volume is a revised reprint from Oxford Loose-Leaf Medicine. It gives a most readable epitome of today's concept of gout, causation, diagnosis, gloomy prognosis, and palliative treatment.

Hench gives its incidence at Rochester as at least 5 percent of all joint diseases. This is beyond what would be considered the figures on this side of the Atlantic. An unanswered question is, why the markedly more frequent occurrence in England? Port and high living can no longer take the blame.

Talbott and Christian have covered morbid anatomy and differential diagnosis thoroughly, with 50 microphotographs and x-rays. This reviewer recently saw a classical gout attack in a case of generalized Paget's. Two such cases are reported by the authors.

The authors agree with Sydenham's views as to the disease's incurability, and "believe that, once the diagnosis is established, the patient will have the disease throughout life". They perorate with the following from Ellwanger's Meditations on Gout:

"Perchance the most philosophical way for the sufferer is to take up a treatise of medicine, and perusing it attentively, note the innumerable ills that flesh is heir to which are infinitely worse than his own. And while he ponders over life's uncertainties and recognizes that mankind was created to suffer and endure, as well as to rejoice and enjoy, if he be a minute philosopher he may conclude his reflections with this corollary, as were he not afflicted with gout he must * * * pay the penalty of living; and what can a man live long enough to know except that he is born to die."

PANCREATIC FUNCTION AND PANCREATIC DISEASE, Studied by Means of Secretion by *Henrik O. Lagerlöf, M. D.*; translated by *Helen D. Frey*; with a foreword by *Joseph H. Pratt, M. D.* 289 pages. The Macmillan Co., New York, publishers, 1942. Price \$3.50.

This excellent monograph, a translation of the important work of Dr. Berglund and his coworkers on an important gastro-intestinal organ, is timely. Generalized abdominal pain, or pain in the left epigastrium and splenic flexure regions in the absence of demonstrable pathology in the stomach, liver, gallbladder, spleen, kidneys, and intestine has generally been ascribed to the presence of abnormal spasm of the smooth muscle of the colon, and has been diagnosed as "irritable colon." It constitutes the most common disorder encountered by gastro-enterologists, in normal times. With the stress of war both at home and at the various fronts, this entity appears more common. Dr. Lagerlöf describes concretely the symptoms of acute and chronic pancreatitis and the useful laboratory aids. Recognition of the similarity of the symptoms along with the aid of the laboratory procedures will certainly place many cases previously diagnosed as "irritable colon," into the chronic pancreatitis group.

The section on the theories of normal pancreatic secretion and the development of the secretin theory is good physiology, with complete bibliography. The conclusion is that the hormone secretin regulates the fluid and bicarbonate secretion, while the vagal and parasympathetic fibers are concerned mainly with the enzyme secretion.

The author has devised a special technic for collecting the pancreatic secretion following the injection of secretin free of gastric and salivary contaminants. Methods for the determination of the various pancreatic enzymes as well as for the fixed bases are described in detail. He observed no ill effects from the use of secretin, and he ascribes those reported to the use of impure products. Blood and urine amylase determinations in pancreatic disease are considered the most valuable by the author. They show elevated values during the first 2 days of acute pancreatitis and often are elevated in chronic pancreatitis. Though not specific they are considered important adjuncts in making the diagnosis. Blood bilirubin determinations aid in differentiating pancreatitis from gallbladder disease.

The discussion on the anatomy and pathology of the pancreas is concise and accurate. The clinical discussion of the various diseases of the pancreas is brief but with proper emphasis on the important differential diagnostic features. This portion is supplemented by the detailed case history reports of various pancreatic diseases which offer a great fund of information for any one interested in this hidden organ.

INDIGESTION, Its Diagnosis and Management with Special Reference to Diet, by *Martin E. Rehfuess, M. D., Professor of Clinical Medicine, and Sutherland M. Prevost, Lecturer in Therapeutics, Jefferson Medical College, Philadelphia.* 556 pages with 63 illustrations. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$7.

This book is the work of an authority who presents in a practical and interesting style diagnostic procedures and therapeutic regimens that he uses in his own practice.

The author tells how to classify the various types of indigestion and the probable prognosis in each. In connection with diagnosis the significant factors of history taking and physical diagnosis are brought out with appropriate coverage of gastric and duodenal analysis, x-ray examination, gastroscopy and gastrophotography. Indigestion due to nervousness, allergy, infection, gastric functional disturbances, chronic gastritis, ulcer, malignancy, biliary tract disease, disease of the cardiovascular system, old age, menopause, and indigestion in war-time are particularly emphasized with specific treatment for each.

There is a 271-page coverage of diet in which a fresh biological approach that fits into modern medical concepts is incorporated.

This book is timely and would be useful in both office and bedside practice.

PRIMER OF ALLERGY, A Guidebook for Those Who Must Find Their Way Through the Mazes of This Strange and Tantalizing State, by *Warren T. Vaughan, M. S., M. D., Richmond, Va.* Second edition. 176 pages with illustrations by John P. Tillery. The C. V. Mosby Co., St. Louis, Mo., publishers, 1943. Price \$1.75.

This book is primarily for those unfortunate individuals suffering from one or more of the varied allergic manifestations. Symptoms are explained in simple language and an explanation is offered as to why one patient reacts differently from others. It is written in an entertaining manner and the numerous illustrations depict, in an amusing way, some of the trials that must be endured by the allergic individuals.

The skin test, its value and shortcomings, is explained. Elimination diets and diets in general are discussed, as well as numerous other methods for the relief of the victims of allergy. It is an excellent book for the suffers of allergic conditions and can be read to advantage by the medical profession.

MANUAL OF INDUSTRIAL HYGIENE and Medical Service in War Industries, issued under the auspices of the Committee on Industrial Medicine of the Division of Medical Sciences of the National Research Council. Prepared by the Division of Industrial Hygiene, National Institute of Health, United States Public Health Service. *William M. Gafaser, D. Sc., Editor.* 508 pages. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price, \$3.

This volume is prepared by the Division of Industrial Hygiene, National Institute of Health, United States Public Health Service,

and is issued under the auspices of the National Research Council. As such it emanates from authoritative sources, and is entitled to the most careful consideration and critical appraisal.

In the strict sense of the word this is not a manual, if by that is meant a condensed, relatively complete outline or digest of the field. The discussions of occupational disease and occupational dermatoses are sketchy and incomplete, and important subjects like poisoning due to some of the newer solvents, and dermatitis following exposure to halogenated hydrocarbons and fiber-glass are mentioned briefly or not at all, although the book is specifically directed toward the problems of war industry. The section on engineering control of air contaminants is excellent, and contains several valuable tables, but omits all reference to methods of laboratory analysis. Despite obvious attempts at condensation, the three chapters on occupational disease, occupational dermatoses, and air contaminants contain much repetitious material and material of dubious value which could well be eliminated in a volume of such limited size.

The principal virtue of the manual is its emphasis on the problem of maintaining the health of the industrial worker. The control of communicable disease, the provision of facilities for medical care of workers and their families, the relief of fatigue, and the improvement of nutrition, plant sanitation, and the physical environment of the worker are among the topics discussed at considerable length and from a balanced point of view. Those of us in industrial hygiene are only too conscious of the importance of these factors and their relationship to absenteeism and production. This volume gives them their rightful place.

While this book does not fulfill the promise of its preface " * * * to cover the entire subject" and its title is a misnomer, it is highly recommended for its exposition of the basic philosophy which should underlie present-day industrial hygiene practice.

SYNOPSIS OF DISEASES OF THE SKIN, by *Richard L. Sutton, M. D., Emeritus Professor of Dermatology, University of Kansas Medical School*, and *Richard L. Sutton, Jr., M. D., Assistant Professor of Dermatology, University of Kansas Medical School*. 481 pages; 413 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$5.50.

This synopsis is brief and surprisingly complete. The book should be welcomed particularly by the general practitioner as very rare diseases are not included. The authors are very clear and concise as to therapy.

They do not mention numerous treatments for each disease as do larger texts, thus catapulting the general practitioner into confusion. The classification of skin diseases is excellent and the short chapters on anatomy, etiology and physiology make the text much more understandable.

TREATMENT OF FRACTURES, by *Guy A. Caldwell, M. D., F. A. C. S., Professor of Orthopedic Surgery, Tulane University of Louisiana School of Medicine.* 303 pages with 92 illustration. Paul B. Hoeber, Inc., New York, publishers, 1943. Price \$5.

Dr. Caldwell has written a very timely book on the treatment of fractures. He has managed to present in a condensed form acceptable methods of treatment for all ordinary fractures without omitting essential information.

The methods used give maximum results with minimum of equipment.

The chapters covering general principles of management of simple and compound fractures are particularly well written.

This book should be most welcome at this time because of the large number of men from general practice being brought into military service. They will find in it a clear, concise, readable guide for treatment of fractures which is not too voluminous and time consuming.

NEUROANATOMY, by *Fred A. Mettler, A. M., M. D., Ph. D., Professor of Anatomy, University of Georgia School of Medicine, Augusta, Ga.* 476 pages; 337 illustrations, including 30 in color. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$7.50.

This well written book is designed as a text for medical students beginning the study of neuroanatomy. The illustrations and drawings are original, ample and excellent.

There is a division into two sections: The first dealing with the gross aspects and the second with microscopic neuroanatomy.

Common technical terms are used and whenever neurologic terms first appear, they are defined and the BNA equivalent or alternative terms follow in parentheses.

The material presented is considered only as a bare outline for fuller further study. With this end achieved, a long list of references, most of them to American journals because of the greater usefulness to the average medical student, is appended.

The printing and binding are very good.

TEXTBOOK OF ANATOMY AND PHYSIOLOGY, by *Diana Clifford Kimber; Carolyn E. Gray, A. M., R. N.; and Caroline E. Stackpole, A. M., Associate in Biology, Teachers College, Columbia University.* Eleventh edition. 769 pages; illustrated. The Macmillan Co., New York, publishers, 1942. Price, \$3.

The authors have tried in the preparation of this textbook to meet the requirements of the National League of Nursing Education. This edition contains much new material, some of it replacing parts that were in need of revision in the light of more recent knowledge. A greater number of illustrations has been included, others improved; color has been used extensively to clarify the drawings.

Those who have used other editions of this book know that for its intended purpose it is a complete treatment of the subject. The

enlarged sections dealing with circulation and digestion are particularly thorough. The chapters on cells and their activities are well written and have clear discussions. The systematically constructed charts and summaries are a great help in organizing for the student the content of various chapters. A list of reference books and a glossary have been included to help the reader.

This book should continue to meet the demands for a well organized and fairly extensive text on anatomy and physiology.

ESSENTIALS OF PROCTOLOGY, by *Harry E. Bacon, B. S., M. D., F. A. C. S., F. A. P. S., Professor and Head of the Department of Proctology, Temple University Medical School and Hospital*; introduction by *Curtice Rosser, B. A., M. D., F. A. C. S., F. A. P. S., Professor of Proctology, Baylor University, Dallas, Tex.* 345 pages; 168 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1943. Price \$3.50.

Essentially this work is a condensation of the author's excellent and well-known encyclopedic text, "Anus, Rectum, and Sigmoid Colon." As such, the present small volume is extensive in scope and the material clearly and ably presented. The text is clarified by numerous well-drawn illustrations. These occasionally are repetitious; figures 10, 26, and 83 for instance, illustrate the same model of fenestrated anoscope. Similarly, paragraph headings are listed at the head and in the body of each chapter.

The surgical treatment of fissure, abscess, fistula, and hemorrhoids are well presented. Unnecessarily included occasionally are obsolete methods, such as the use of the constricting seton in the treatment of fistula and the local treatment of ulcerative perianal tuberculosis by applications of silver nitrate or argyrol. Furthermore, in the treatment of bacillary dysentery the use of orally administered sulfonamides is not mentioned. There is little fare for military men in the two-page chapter devoted to "Injuries of the Rectum," interested as they are in traumatic lesions.

Amebiasis and pruritus ani are well and completely considered, as are the large and extensive chapters on tumors.

ESSENTIALS OF GYNECOLOGY, by *Willard R. Cooke, M. D., F. A. C. S., Professor and Head of the Department of Obstetrics and Gynecology, University of Texas.* 474 pages with 197 illustrations, including 10 in color. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1943. Price \$6.50.

This book is well named, for it is absolutely limited to the bare essentials of gynecology; it is an excellent treatise for the student, teacher and general practitioner, for its conciseness and brevity make it ideal for review or reference. The volume stresses the fundamentals and is refreshing by its absence of inert, voluminous, and unimportant detail, its very rudimentary and terse discussions will be well accepted by the profession, and its well organized outline will be of great benefit to the student. This small volume presents a ready

picture of the conditions to be met in everyday practice. The illustrations are not too plentiful but those present are excellent and vivid.

Chapter 17 on the general principles of operative treatment is very well written, and this by itself makes the book well worth while. Chapter 18 on the more commonly useful operations of gynecology is somewhat unique, as it outlines very briefly the steps of each surgical procedure; there are no illustrations in this chapter, and this, plus the brevity of the discussion, may make it difficult for the inexperienced gynecologist or student to appreciate. It is, however, very well done for this type of outline. The clear, logical thoughts throughout many of the chapters, especially with reference to female psychology, are frank and human. This book is recommended particularly for students and teachers but it would be a welcome addition to the library of any gynecologist; its highest virtues are its terseness and brevity, its sparing of unnecessary words, and its crystal-clear, concise, orderly presentation.

FLYING MEN AND MEDICINE, *The Effects of Flying Upon the Human Body*, by *E. Osmun Barr, M. D.* 254 pages; illustrated. Funk & Wagnalls Co., New York, publishers, 1943. Price \$2.50.

This is an excellent book for the layman concerning aviation medicine. The language is nontechnical, and the subject matter with illustrations and diagrams is presented in a logical manner, making is readily understandable and interesting.

One cannot fail to appreciate the reason for the physical standards required of man, a surface animal, to enable him to withstand successfully the stresses and forces of a new environment.

The author's contribution is a welcome and timely answer to the queries, doubts and fears of a war conscious public concerning physical fitness and flying.

BLOOD GROUPS AND TRANSFUSION, by *Alexander S. Wiener, A. B., M. D., Serologist and Bacteriologist in the Office of the Chief Medical Examiner of New York City; Head of Transfusion Division, The Jewish Hospital of Brooklyn, New York.* Third edition. 438 pages with 69 figures and 106 tables. Charles C. Thomas, Springfield, Ill., publishers, 1943. Price \$7.50.

The third edition of this book which has become a standard text on blood groups and blood transfusions brings it completely up to date. Two new chapters have been added, one on the use of stored blood and blood substitutes and the other on the Rh factor. The entire book has been revised and reset. The general format of the book remains unchanged.

The use of blood transfusions being of such military importance and the author being undoubtedly one of the leading American investigators in this field, one can unhesitatingly advise that this book be available in any installation wherever blood transfusions are

performed in any number. It is to be hoped that the next edition will add to the 15 pages at present devoted to the entire subject of plasma, serum and blood substitutes.

CHEMOTHERAPY OF GONOCOCCIC INFECTIONS, by *Russell D. Herrold, B. S., M. D., Associate Professor of Surgery (Urology), College of Medicine, University of Illinois, Chicago, Ill.* 137 pages. The C. V. Mosby Co., St. Louis, Mo., publishers, 1943. Price \$3.

This is an excellent and thorough presentation of the sulfonamides in the treatment of gonococcus infections. It is concise and to the point. Emphasis is well placed on the overzealous and prolonged use of the sulfonamides, with a timely warning of their dangers.

The measures advocated for the determination of cure are more prolonged and complete than are used by most individuals and clinics, but they approach the ideal, and if we are to eliminate the gonococcus carriers produced by sulfonamide therapy, such measures will have to be adopted by all.

The chapters on "The Management of Sulfonamide Failures" and "Illustrative Case Histories" should be of great value to the inexperienced, especially those in the service, who are suddenly placed in the position of treating gonococcus infections.

The book is well written, handy in size, and indexed for easy reference. Because it is concise and thorough it is especially recommended for all who heretofore have had no interest in the treatment of gonococcus infections and must learn in a hurry.

LABORATORY EXPERIMENTS IN PHYSIOLOGY, by *W. D. Zoethout, Ph. D., Professor of Physiology in the Chicago College of Dental Surgery (Loyola University).* 256 pages; 88 illustrations. Third edition. The C. V. Mosby Co., St. Louis, Mo., publishers, 1943. Price \$2.25.

This edition differs from the second only in the addition and removal of a few experiments and a revision of some of the paragraphs dealing with the preparation for performing various experiments. The first chapter gives directions for experiments designed to acquaint the student with fundamental experimental physiological apparatus. The manual covers most of the phases of physiology usually included in a course in human or mammalian physiology. The student becomes familiar not only with physiological principles but with standard clinical and laboratory apparatus.

The author does not include combined mammalian experiments in which several principles are studied in one exercise and on one dog, thereby effecting a conservation of time and laboratory animals. The term "pH" appears nowhere in the entire book and the experiment demonstrating the effect of hydrogen ions on enzymatic action seems inadequate. No experiments employing the plethysmograph are included nor are there experiments to demonstrate the role of the auto-

onomic nervous system in the regulation of secretion and muscular action in the digestive system. An experiment involving elementary gas analysis would be a valuable addition to the chapter on respiration. There is no bibliography.

Nevertheless, there are experiments of sufficient number and variety to make the book a useful laboratory guide for courses ranging from elementary human physiology (including rudiments of physiological chemistry) to (with some additions) advanced mammalian or medical physiology. From experience with the second edition, both as a student and in teaching, the reviewer feels that the clear, concise directions and the general organization of material are ideal for laboratory use. It is well bound and printed on light green nonglossy paper.

SYNOPSIS OF PATHOLOGY, by W. A. D. Anderson, M. A., M. D., *Assistant Professor of Pathology, St. Louis University School of Medicine; Pathologist, St. Mary's Group of Hospitals*. 661 pages; 294 text illustrations and 17 color plates. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price \$6.

The author has undertaken a difficult task in attempting to present this outline of pathology, and in general he has done it well. In most instances the distribution of space to the various subjects is in proportion to their importance. Perhaps he could have given more pages to neoplasms and to vascular diseases of the kidney.

Many valuable photomicrographs are included and the photographs of gross specimens are excellent. Further, they are selected in such a fashion as to demonstrate the lesions of greatest frequency.

Several valuable charts, which aid in differentiating the histologic changes of somewhat comparable entities, are included. The bibliography is varied and includes references to the more comprehensive and authoritative works of the present day. Binding and printing are of a character to insure durability and ease of reading.

In summary this is a well organized synopsis of pathology which justifies the thought behind its publication.

A TEXTBOOK OF PATHOLOGY, An Introduction to Medicine, by William Boyd, M. D., LL. D., M. R. C. P., Ed., F. R. C. P., Lond., Dipl., Psych., F. R. S. C., *Professor of Pathology and Bacteriology in the University of Toronto*. Fourth edition. 1008 pages; 490 engravings and 29 colored plates. Lea & Febiger, Philadelphia, publishers, 1943. Price \$10.

Boyd's fourth edition of his textbook of pathology maintains the same standard of excellence achieved by its predecessors. In order to keep it on a high plane he has revised many chapters and added delineations of new lesions. This has been done without sacrificing necessary data. For any who do not have the opportunity to read the whole volume, Boyd, in his preface, enumerates the entities which have received his most recent attention. Many of his followers will wish to know his views on these subjects.

As has been his practice in the past, he continues to bridge the gap of the basic sciences and the clinical fields by including a list of signs and symptoms associated with the more common pathologic states. This makes the subject of pathology somewhat more interesting to students. Similarly he includes phases of physiology, bacteriology, and biochemistry in his discussions of anatomical changes.

By the use of small type and succinct phrasing, he is able to give brief summaries of many conditions such as crush nephritis, Weil's disease, uveoparotid fever, and others not commonly seen, but with which the student should have a cursory acquaintance.

The photographs and photomicrographs are well selected and readily applicable. Several new colored ones have been added which enhance the value of the volume.

His references have also been brought up to date and include those of proved worth as well as later ones on new subjects.

In summary, this fourth edition of Boyd's text possesses all of the merits of the three previous ones enhanced by the author's adequate interpretation of the more recent work on old and new diseases.

DICTIONARY OF BIO-CHEMISTRY AND RELATED SUBJECTS, by 46 prominent contributors, *William Marias Malisoff, Professor of Bio-chemistry, Polytechnic Institute of Brooklyn, Editor-in-Chief.* 579 pages. Philosophical Library, Inc., New York, publishers, 1943. Price \$7.50.

Like any adventure in the new, this book should provoke considerable controversy. Arranged in an eccentric manner, its title of dictionary is decidedly inappropriate. Lengthy treatises on the various subjects more aptly categorize it as an encyclopedia. Its value as an encyclopedia, however, falls short of its aspirations. Compiled by collaborators eminent in their own right, the work is thus given an unusual authoritative appeal. Technically it has much to desire. The presentation of some of the formulae and tables, for example, is of such fine point that reading becomes difficult and it detracts from the appearance of the volume.

Of a highly specialized character, the work should prove useful as an authoritative reference book particularly on the topics that are fully discussed.

SHIPWRECK-SURVIVORS, A Medical Study, by *Macdonald Critchley, M. D., F. R. C. P., Surgeon Captain, R. N. V. R.; Consultant in Neurology to the Royal Navy.* 119 pages with 11 illustrations. J. & A. Churchill, Ltd., London, England, publishers, 1943. Price 7s. 6d.

Dr. Critchley has written a very timely and informative booklet on the hazards and pains of shipwreck, on the thirst, the hunger, tropical hardships, and arctic immersions. It is a sketchy little volume, giving most of its pages to the history and drama of wreck and exposure. Experiences of the early British Navy and of merchant shipping through the past two centuries are cited cursorily but dramatically.

There is no question about its being interesting reading. It is a small thriller, a sea tale, to be read as one might a Nordhoff and Hall, not laid down till finished.

But the same cannot be said of its constructive use. The author has more enjoyed covering the literary aspect than he has the drabber features of prevention and treatment. These are comparatively briefly summarized. Bumed's pamphlet on "First Aid Treatment For Survivors of Disasters at Sea," has more nuggets of wisdom in that respect.

However, it's a nice little volume for your small bookshelf. It makes entertaining reading.

IS GERMANY INCURABLE? by *Richard M. Brickner, M. D.*, with introductions by *Margaret Mead, Ph. D.*, and *Edward Strecker, M. D.*, 318 pages. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1943. Price \$3.

Economists, statesmen, sociologists, and others have proposed answers to the question, "Is Germany Incurable?" Doctor Brickner phrases a psychiatrist's answer to the problem of Nazism by first presenting his version of a valid history in accordance with standard psychiatric procedures. His case history of the nation is not unlike that obtained from the family and friends of a patient with a grave mental illness. The factual data, which he feels are professionally significant, are culled from the reports of interested, impartial observers. Principally, he relies upon historians, foreign correspondents, news analysts, philosophers, and sociologists who have recorded their impressions of the philosophy, growth, and development of Pan-Germanic Nationalism. To this he adds a graphic longitudinal analysis of what might be termed its psychobiology, covering its life span of five generations. The complete picture is that all-too-familiar array of socially warped patterns—Nazism.

Doctor Brickner's reasoning and method of presentation is analogical. He first formulates the criteria for the diagnosis of paranoid trends in a single individual and illustrates these with case reports. He then postulates, with the similarity of findings in the life history of the German Nation, that it is tenable to view Nazi Germany as a paranoid member of the family of nations. His plan for treatment and cure is similar to the regimen instituted for the management of a homicidal psychotic: Custodial care, recognition of the futility of logical reasoning as a basis for common understanding, and psychotherapeutic access through those "clear channels" when and if they are available.

Dr. Brickner vividly presents the need for a clear psychiatric understanding and treatment of an endemic social disease which threatens the life of our civilization, by assuming pandemic proportions. If he fails to carry through convincingly his analogy between the mental

disease of an individual and its equivalent in the social trends of a nation, it is because of the inherent limitations of the theory. It is this which weakens both his diagnosis and recommended therapy. Groups and single individuals have different kinds of life histories and it is not reasonable to view them both in the same frame of reference. Social psychiatry needs to develop a nosology of its own based on modern anthropological and sociological concepts rather than being forced to depend upon the applicability of standards suitable for the classification of single individuals.

MIND, MEDICINE, AND MAN, by *Gregory Zilboorg, M. D.*, with a foreword by *Arthur H. Ruggles, M. D.* 344 pages. Harcourt, Brace and Co., New York, publishers. 1943. Price \$3.50.

This volume is written for the layman and attempts to clarify the conflicts of theory which have beset the science of psychiatry. The work is presented from the viewpoint of an orthodox Freudian psychoanalyst with all that this implies. He is frankly critical of the newer shock therapies and states that even those who administer these treatments do not know why they produce the results. After a lengthy apologia for Freudian doctrine, he says of those who espouse shock therapy for mental disease, "Vague and untenable theories are offered which not only the layman but even the well-trained medical man will not understand."

The chapter on "Crime and Judgment," in which the style changes to the form of a familiar essay and a plea for more enlightened handling of criminals who are mentally ill, is rather well done. In this chapter the author is upon firm ground and presents a strong case.

The last chapter entitled "Psyche, Soul, and Religion" is rather confusing. In it the author attempts to demonstrate that basically there is no conflict between psychoanalysis and religion and that someone could probably do for psychoanalysis what Thomas Aquinas did for Aristotle's Philosophy. He believes that the theologians have confused Freud's personal belief with the basic tenets of psychoanalysis. Whether the author is successful in doing anything at all with this chapter is open to conjecture.

Obviously the book is of little value to the military psychiatrists, and in general the best that can be said for it is—interesting.

DOCTOR IN THE MAKING, The Art of Being a Medical Student, by *Arthur W. Ham. M. B.*, Associate Professor of Anatomy, in Charge of Histology, Faculty of Medicine, University of Toronto; and *M. D. Salter, M. A., Ph. D.*, Lecturer and Research Fellow in the Department of Psychology, Faculty of Medicine, University of Toronto; illustrated by *Jean McConnell*. 179 pages; 12 illustrations. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1943. Price \$2.

The work of these two authors in showing the difficulties encountered by medical students is very well handled and should be read

before his freshman year by every student contemplating the study of medicine. While this book is primarily for senior highschool students and college freshmen, it will make interesting reading for the individual interested in education or psychology to review the learning process as brought out in this work.

It is well arranged, of readable type and of sufficient length to carry fully their message without it becoming tiresome reading. This book is highly recommended for reading and should be included in the required reading lists of those students planning on entering the field of medicine or its allied branches.

TEXTBOOK OF PERIODONTIA, by *Samuel Charles Müller, D. D. S., F. A. C. D., Associate Professor of Periodontia in charge of Periodontia Department, New York University College of Dentistry, Lieutenant, Dental Corps, United States Naval Reserve*; with the cooperation of members of the Periodontia Staff of New York University College of Dentistry. Second edition. 733 pages; illustrated. The Blakiston Co., Philadelphia, Pa., publishers, 1943. Price \$9.50.

This book brings together the fundamentals and essentials of the preservation of healthy, normal periodontal tissues and the correction of their pathologic abnormalities. Physiology, histopathology, etiology, diagnosis and treatment are presented in a thorough and systematic manner.

Numerous photographic illustrations are particularly well presented and they bring out the desired tissue conditions throughout the text.

Much can be derived from the chapter on instrumentation which shows the proper armamentarium and methods and reason of manipulation. Chemotherapy and diet are thoroughly presented in the volume, which takes into consideration the vitamin family with histories and descriptions.

The text is well written and neatly arranged in large size print, which makes reading easy.

OPERATING ROOM TECHNIQUE, by *Edythe Louise Alexander, R. N., Supervisor of the Operating Rooms of The Roosevelt Hospital, New York City*. 392 pages with 221 illustrations. The C. V. Mosby Co., St. Louis, Mo., publishers, 1943. Price \$3.75.

They who are concerned with surgery in any way know that co-operation between the surgeon and his assistants, in fact, the whole staff is essential if the best results of an operation are to be obtained. This teamwork is dependent on the quality of a series of previously arranged tasks based on fundamental principles as well as experience.

Complete, though short, is the first section describing operating room planning and maintenance. The work details that are outlined will be of use to many readers. Information to aid in staff organization follows; then notes on sterilization and cleaning. A chapter on suture materials is a well written, thorough treatment of that subject.

Basic routines and related precautions for nurses are given with a detailed outline of nurses' duties during an operation.

Throughout the book the written material is well illustrated with 221 photographs and sketches showing routine procedures, surgical positions, methods for setting up equipment, and operative procedures. The full-page photographs of surgical instruments might easily be projected on a screen for the purpose of classroom instruction.

For the student the book is only a manual, it does not contain theory; it lacks also a bibliography; to use it properly would require supplementary reading. It does, however, answer the purpose for which it was written. Fifteen chapters describe technics for surgical operations on various parts of the body and include definitions, lists of instruments and other materials, the preparation of the patient, and good outlines of the operative procedures.

TEXTBOOK OF SURGICAL NURSING, by *William F. MacFee, A. B., M. D., F. A. C. S., Director of Surgery, St. Luke's Hospital, New York; and Manelva Wylie Keller, B. S., R. N., Formerly Chief Operating Room Nurse, St. Luke's Hospital, New York.* Fourth edition. 559 pages; illustrated. The Macmillan Co., New York, publishers, 1942. Price \$3.50.

This edition has not been greatly changed, but newer information has been added, such as up-to-date cardiovascular material, the application of sulfonamide drugs, the use of blood plasma, and suction therapy. Emphasis is placed on specific nursing measures for definite diseases. In nine units the various major systems of the body are considered in the light of surgery and surgical nursing correlated with medical diseases. The authors display an intelligent understanding of nursing care.

The introduction presents a chapter on surgical terminology, a useful part of this type of elementary text. An outstanding chapter is the one entitled "Post Operative Recovery and Complications." Well-chosen review questions follow the chapters; the illustrations, particularly those of surgical instruments, are good. The book contains no bibliography.

The authors intend their book to deal with surgical nursing in only a general way. They have omitted theory and involved discussions, intending to allow the instructor's interpretation to meet these other requirements. Thus the book is limited in use to beginning classes in surgical nursing; it could hardly be considered of value as a reference book. Perhaps the authors invite controversy with such statements as "many patients will not need any mental preparation * * * in connection with their operation." However, as a text to precede the use of a more advanced book this new edition is acceptable.

COMMUNICABLE DISEASE NURSING, by *Theresa I. Lynch, R. N., Ed. D., Instructor in Education, New York University; Formerly Superintendent of Nurses and Director of Instruction, the Willard Parker Hospital, New York City.* 678 pages; 156 text illustrations and 5 color plates. The C. V. Mosby Co., St. Louis, Mo., publishers, 1942. Price, \$3.75.

Part one of this textbook is background material to acquaint the reader with general principles concerning communicable diseases, their prevention and control. Especially worth while is the advice to nurses regarding personal care to protect their own health. The chapter on medical asepsis is outstanding; alone it contains 82 illustrations in addition to the well-written text giving clear instructions for various technics.

Part two discusses in a systematic way the medical aspects and nursing care of over 40 different diseases. Five good color reproductions are valuable additions to the material on measles, chickenpox, and scarlet fever.

Parts three and four take up tuberculosis and venereal diseases, respectively. Their importance merits them this more lengthy treatment.

Part five includes a useful chapter on the home care of communicable diseases and reminds the reader of the importance of public health programs. Perhaps the student nurse may here be led to realize the significance of her community work with communicable diseases. It is appropriate that the book should end with a brief survey of opportunities for nurses with communicable disease training.

Apparently this book is an attempt to simplify the instruction in this field but not at the expense of a fairly thorough treatment of the subject. The author states that the technics outlined are not adapted to universal application, nor are they final because medical progress is rapid. Supplementary reading is suggested and encouraged by reading lists following each chapter. Certainly the appendix, with its discussion of some of the less common diseases, and with over 30 pages of additional nursing procedures, is a valuable part of the book. A glossary is also appended.

STANDARD NURSING PROCEDURES OF THE DEPARTMENT OF HOSPITALS, CITY OF NEW YORK, prepared by the *Committee on Nursing Standards, Division of Nursing, Department of Hospitals, Mary Ellen Manley, R. N., M. A., Director.* 436 pages. The Macmillan Co., New York, publishers, 1943. Price \$3.25.

This book describes nursing procedures that have been adopted by the Department of Hospitals of New York City; however, they are for the most part the commonly used technics. Special nursing procedures are discussed, pediatric nursing is included, and there are frequent suggestions as to how procedures may be adapted to the treatment of children. Basic nursing care, though, is the chief content of the book; fundamental principles are presented so that they may

be used as a foundation on which to build a course of instruction with which a text giving the scientific principles was to be used. The latter is assumed in this book.

Used as it is intended as a guide to scientific nursing which meets individual needs, it is an acceptable book.

STUDIES IN ETHICS FOR NURSES, by *Charlotte A. Aikens, R. N., Formerly Superintendent of Columbia Hospital, Pittsburgh, and of the Iowa Methodist Hospital, Des Moines.* Fifth edition, thoroughly revised. 378 pages. W. B. Saunders Co., Philadelphia, Pa., publishers, 1943. Price \$2.50.

This book might be used to advantage by young student nurses entering training; graduate nurses will already have become acquainted with these principles and problems concerning professional adjustment. This is a very general discussion of nursing ethics, one that leaves the interpretation in many instances up to the instructor or student which may stimulate thought but which may also leave some students in doubt. The chapters are easily understood; review questions following each chapter are helpful.

Aside from the fact that Navy nurses have already had instruction in professional adjustment before entering the service, this book is not particularly applicable to life in the Navy Nurse Corps where regulations and military relationships alter the conditions under which nurses live and work.

QUICK REFERENCE BOOK FOR NURSES, Compiled and Arranged from Various Sources by *Helen Young, R. N., Director of Nursing, Columbia Presbyterian Medical Center*; with the assistance of *Georgia A. Morrison, R. N., Formerly Assistant Director, School of Nursing, Presbyterian Hospital, New York City*; and *Margaret Eliot, R. N., Assistant Director of Nursing, Columbia Presbyterian Medical Center.* Fifth edition, completely revised. 575 pages. J. B. Lippincott Co., Philadelphia, Pa., publishers, 1943. Price \$2.

In the latest edition of Lippincott's Quick Reference Book for Nurses, the authors have presented a concise and useful book which covers the principal nursing subjects in outline form. The material is arranged alphabetically to facilitate its use as a reference book.

Each nursing subject is fairly well covered and up to date. For example, the section devoted to materia medica discusses the latest drugs including the sulfonamides.

There are also several insertions in this edition which should be of special interest, e. g., diseases encountered by the armed forces, poison gases, shock and immunization.

Student and graduate alike will find it invaluable as a review book.

THE DIVISION OF PREVENTIVE MEDICINE

Commander T. J. Carter, Medical Corps, United States Navy, in Charge

TOXIC EFFECTS OF ARSENICAL COMPOUNDS AS ADMINISTERED IN THE UNITED STATES NAVY IN 1942 WITH SPECIAL REFERENCE TO ARSENICAL DERMATITIS

THOMAS J. CARTER
Commander (MC), U. S. N.

WESLEY M. CHAMBERS
Chief Pharmacist, U. S. N.

and

LAURA T. ANDERSON
Administrative Assistant
Bureau of Medicine and Surgery

For the past 18 years medical officers of the Navy have been required to submit to the Bureau of Medicine and Surgery reports of the number of doses of arsenicals administered and the reactions therefrom. This information has been compiled and published in the following BULLETINS:

September 1925	October 1933	October 1937	January 1941
January 1927	October 1934	January 1938	October 1941
January 1929	January 1935	October 1938	January 1942
July 1930	October 1935	January 1939	October 1942
October 1931	January 1936	October 1939	January 1943
October 1932	October 1936	January 1940	
April 1933	January 1937	October 1940	

In table 1 is shown the number of doses of each arsenical administered in the year 1942, the number and type of reactions and similar data for the 18-year period, 1925-42. It is noted that in 1942 there was 1 reaction to 3,489 doses and 1 death to 122,106 doses. For the 18-year period, 1925-42, there was 1 reaction to 1,600 doses and 1 death to 36,123 doses.

TABLE 1.—*Arsenicals, U. S. Navy, 1942 and 1925-42; type of drug, reaction, and ratio of doses to reactions*

	Number of doses administered	Reactions				Ratio of reactions to doses 1 to —	Ratio of deaths to doses 1 to —
		Mild	Severe	Fatal	Total		
Year 1942:							
Acetarsons.....	42	0	0	0	0	0	0
Bismarsen.....	665	0	0	0	0	0	0
Mapharsen.....	109,095	18	9	0	27	4,041	0
Neocarphenamine.....	9,756	3	4	0	7	1,394	0
Silver arsphenamine.....	5	0	0	1	1	0	5
Sulfarsphenamine.....	69	0	0	0	0	0	0
Tryparsamide.....	2,474	0	0	0	0	0	0
Total.....	122,106	21	13	1	35	3,489	122,106
18 year period 1925-42:							
Acetarsons ¹	1,013	1	0	0	1	1,013	0
Arsphenamine.....	41,558	27	14	1	42	989	41,558
Bismarsen ²	4,356	0	0	0	0	0	0
Mapharsen ³	397,680	53	23	1	77	5,165	397,680
Neocarphenamine.....	1,364,814	633	319	50	1,002	1,362	27,296
Silver arsphenamine ⁴	591	0	1	1	2	296	591
Sulfarsphenamine.....	30,903	17	8	0	25	1,236	0
Tryparsamide.....	73,604	3	1	0	4	18,401	0
Total.....	1,914,519	734	366	53	1,153	1,660	36,120

¹ Cerebral hemorrhage following the administration of mapharsen.² First administered during the year 1932.³ First administered during the year 1929.⁴ First administered during the year 1935.⁵ First administered during the year 1931.TABLE 2.—*Proportion of reactions of various types, 1929-42*

Classification	Number of reactions	Percent of total reactions	Classification	Number of reactions	Percent of total reactions
Vasomotor phenomena.....	356	38.86	Arsenical neuritis.....	3	0.33
Arsenical dermatitis.....	353	38.54	Acute renal damage.....	3	0.33
Blood dyscrasias.....	45	4.91	Polynuritis.....	1	0.11
Liver damage.....	42	4.59	Borderline hemorrhagic encephalitis.....	1	0.11
Reactions of minor importance.....	28	3.06	Liver damage (doubtful reaction).....	1	0.11
Table reactions.....	26	2.84	Vascular damage (probable adrenal hemorrhage).....	1	0.11
Jarisch-Herxheimer.....	24	2.62	Total.....	916	100.00
Gastro-intestinal.....	20	2.18			
Hemorrhagic encephalitis.....	9	0.98			
Optic neuritis.....	3	0.33			

ARSENICAL DERMATITIS

Dermatitis in some form was observed in 17, or 49 percent of the total reactions in 1942, as compared with 45 percent for 1941. The type of lesion was erythematous in 6 instances, exfoliative in 3, macular in 4, maculopapular in 3, and urticarial in 1. The reactions were classified as 7 mild and 10 severe.

MILD REACTIONS

The seven mild reactions occurred after the following number of injections: One each after the third, fourth, fifth, seventh, ninth, twelfth, and eightieth.

The interval between the injection and appearance of symptoms varied from 1 hour to 2 days. The length of time required for complete recovery varied from 14 hours to 7 days.

MAPHARSEN

Case 1-1942.—The source and date of infection in this case is unknown. The patient was given a diagnosis of syphilis because of repeated positive serological tests.

Antiluetic treatment was instituted on July 8, 1942, and from that date until July 21 the patient was given six injections of mapharsen, a total of 0.37 gm. Four injections of bismuth subsalicylate were given as concurrent treatment.

Forty-eight hours after the last injection of mapharsen the patient reported to the sickbay with a macular splotchy rash on the arms and groin. No treatment was given for this reaction. Recovery in 3 days.

Case 2-1942.—After exposure to infection in July 1942, this patient was given a diagnosis of syphilis because of positive darkfield examinations.

Arsenical treatment began with a 0.03-gm. injection of mapharsen, followed by a 0.045-gm. injection on August 29, and 0.06-gm. injections on September 1, 8, 14, 23, 29, and October 13.

Thirty minutes after the last injection the patient developed urticaria, dermatitis, pruritus, and vomiting. Complete blood count and urinalysis were normal in all respects.

He was given adrenalin in oil, 1 cc. every 4 hours for two doses, 1 gm. of sulfactol intravenously, forced fluids, and confined to bed. Calamine lotion was applied to skin. Recovery was complete in 7 days.

Case 3-1942.—This patient was exposed to infection on August 15, 1942. Diagnosis was established by means of two darkfield examinations, both positive for *Treponema pallidum*.

Arsenical treatment was instituted with a 0.03-gm. injection of mapharsen on September 15, 1942, followed by 0.045-gm. injections on September 19 and 22, and a 0.06-gm. injection on September 26. Nine hours after the last injection the patient's temperature was 103.2° F. He developed a diffuse maculopapular rash and some urticarial wheals which were confluent in areas. The rash was distributed over the anterior surface of the body and extremities, being more marked on the thighs. CBC and urinalysis were within normal limits. Recovery in 1 day.

Case 4-1942.—This patient gave a history of a primary luetic infection in 1939, three years prior to enlistment. He stated that treatment with both neoarsphenamine and mapharsen at that time invariably caused a reaction. He was admitted to the sick list on December 20, 1942 with syphilis.

Antiluetic treatment began with a 0.03-gm. injection of mapharsen on December 22, 1942. Two hours later a mild skin reaction appeared in the crotch and in several patches on the abdomen accompanied with itching and redness. There was a reddened area of about 2 by 6 inches in the left inguinal region. The inner aspect of both buttocks was similarly reddened. The margins were vague, blending with the surrounding skin. No treatment was given for the reaction. Recovery in 3 days.

Case 5-1942.—After exposure to infection in March 1941, this patient was given a diagnosis of syphilis because of a positive darkfield examination.

From March 5 to July 24, 1941, he received 10 injections of mapharsen, a total of 0.56 gm., and from July 1, 1941, to January 26, 1942, he received 20 injections of bismuth, a total of 2.6 gm.

A second course of arsenical treatment began with a 0.04-gm. injection of mapharsen on October 2, 1941. A slight reaction followed this injection. Another 0.04-gm. injection was given on February 5, 1942, and 6 hours later the patient developed a headache, abdominal pain, generalized malaise, temperature of 99.8° F., and a macular-erythematous eruption.

Symptomatic treatment was instituted with aspirin, grains 10 every 4 hours and forced fluids. Apparent recovery was within 72 hours.

Case 6-1942.—This patient was exposed to infection on July 10, 1942, and was given a diagnosis of syphilis because of the appearance of an initial lesion on the penis, and a 4-plus Kahn blood test.

Arsenical treatment began with a 0.03-gm. injection of mapharsen on September 14, 1942, followed by a 0.02-gm. injection on September 20, and 0.03-gm. injections on September 23, 26, and 30.

Four hours after the last injection a macular rash appeared over the entire body, more marked on the trunk. The temperature was 103.2° F.; pulse 120, respiration 25.

The patient was given bed rest and orange juice fortified with dextrose. Recovery in 14 hours.

Case 7-1942.—After exposure to infection on March 30, 1942, this patient was given a diagnosis of syphilis because of a positive darkfield examination and a 3-plus Kahn blood test.

A 0.03-gm. injection of mapharsen was given on May 29, June 2 and 4, 1942. Isolated, circinated, well-developed, ham-brown macules about 1 cm. in diameter appeared over the body 12 hours after the second injection. The macules were scattered over the body and arms haphazardly, itched severely, and resembled the rash of secondary syphilis. Their presence was hardly noticeable after a period of 4 days.

Twelve hours after the third injection the macules reappeared, but were this time superimposed on wheals about 2 cm. in diameter with pseudopodia.

Pigmented and slightly itching areas at sites of lesions still existed 1 month later.

SEVERE REACTIONS

The ten severe reactions occurred after the following number of injections: One after the first, three after the third, two after the fourth, and one each after the fifth, eighteenth, nineteenth, and forty-fifth. The interval between the injection and appearance of symptoms varied from 1 hour to 25 days. One reaction was believed to have been caused by an accumulative poisoning due to repeated injections and not due to any one injection. The length of time required for recovery varied from 4 to 47 days.

NEOARSPHENAMINE

Case 8-1942.—One month after exposure to infection on November 13, 1942, this patient developed ulcerations involving corona and frenulum of the penis. A darkfield examination was positive for *Treponema pallidum*.

Arsenical treatment began with a 0.4-gm. injection of neoarsphenamine on December 18, 1942, followed by a 0.06-gm. injection of mapharsen on December 22, and a 0.6-gm. injection of neoarsphenamine on December 26.

Four hours after the last injection a sudden sharp rise in temperature to 104.6° F. occurred. The face was flushed with a moderate degree of edema.

conjunctiva was somewhat injected, and a diffuse maculopapular rash with lesions 2 to 4 mm. in diameter, was scattered over the entire trunk, extremities, and face. Urinalysis was negative. All signs and symptoms from the reaction disappeared after 9 days of supportive treatment. Recovery in 16 days.

Case 9-1942.—This patient was exposed to infection on July 20, 1942, and on September 15, 1942, a primary lesion appeared with indurated erosion of the foreskin, and bilateral, shotty, inguinal lymph nodes. Darkfield examinations were positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

Eight hours after an initial 0.3-gm. injection of neoarsphenamine the patient developed a shaking chill and a temperature of 103° F., accompanied by a cough and headache. Physical examination was negative and the temperature subsided within 12 hours. There was a Herxheimer effect as manifested by local irritation of the penile lesion and a swelling of the already enlarged left inguinal lymph node, which appeared to reach a maximum 24 hours after the injection. A second 0.3-gm. injection of neoarsphenamine on September 28 was tolerated without incidence. Ten hours after the third injection of neoarsphenamine (0.6 gm.) on October 1, there was a sudden rise in temperature, headache, and chills. The temperature dropped within 4 hours but there were repeated irregular attacks of chills and fever during the next 5 days. On the fourth day of reaction a generalized erythematous macular eruption appeared. This was on the ninth day following the initial injection, and was clinically consistent with the ninth day erythema of Millian. The rash lasted approximately 2 weeks and consistently showed a triple response to the stroking test. On October 5 a urinalysis showed 20 percent albumin, faint trace of occult blood and no casts. The following day urinalysis showed 10 percent albumin, and occult blood negative. WBC 12,750; RBC 5,660,000.

Treatment for the reaction consisted of 2 APC capsules every 4 hours, forced fluids, alcohol sponges every hour for temperature over 103° F., and thiamine chloride, 5 mg. thrice daily by mouth. He was given two intravenous injections of 1,000 cc. of 10 percent dextrose on October 2, two on October 3, and one on October 6. Recovery in 26 days.

Case 10-1942.—This patient was exposed to infection on September 24, 1942, and was given a diagnosis of syphilis because of a positive darkfield examination.

Arsenical treatment began with a 0.3-gm. injection of neoarsphenamine on October 19, 1942, followed by a 0.45-gm. injection on October 22 and a 0.6-gm. injection on October 25.

Twenty-four hours after the last injection the patient's throat became congested and his temperature began to rise. In the afternoon of the second day the temperature was 101° F. and a diffuse generalized maculopapular rash was observed. Sodium thiosulfate, gr. 5, was given intravenously. Another intravenous injection of sodium thiosulfate, gr. 7, was given the next day. There was no desquamation, although the patient complained of a generalized pruritus for 7 days after the rash had disappeared. Iodobismitol was given intramuscularly when the rash disappeared. This was tolerated well. Blood counts were normal throughout except for a transient increase in eosinophils (3-5 percent). Urine specimens were normal throughout. Recovery in 10 days.

MAPHARSEN

Case 11-1942.—This patient was exposed to infection on June 22, 1942, and developed an initial lesion on the glans penis. A darkfield examination of the lesion was positive for *Treponema pallidum*.

He received 10 injections of mapharsen, a total of 0.555 gm. from June 23 to August 6, 1942, and 10 injections of bismuth, a total of 0.260 gm. from August 13 to October 16. The second course of arsenical treatment, from October 23 to December 24, consisted of 8 injections of mapharsen, a total of 0.48 gm.

About 3 months after starting the first course of mapharsen, signs and symptoms of poisoning occurred. Rash increased gradually during the last 8 to 10 weeks of treatment, concurrent with the second course of mapharsen, and became more severe following the last injection.

Small vesicles which had appeared on fingers and toes for the last year became weeping and spreading during the second course of mapharsen. Exfoliative dermatitis became generalized but was more severe on hands and feet. CBC and urinalysis within normal limits. It is believed that this reaction was caused by an accumulative poisoning due to repeated intravenous injections of mapharsen and not due to any one injection.

Treatment consisted of sodium thiosulfate, gm. 1, intravenously, once daily for 3 days; boric acid compresses to skin lesions; daily intravenous injections of calcium gluconate every other day for three injections; and 1 cc. of liver extract intramuscularly every other day for three injections. Recovery in 47 days from date of last injection.

Case 12-1942.—After exposure to infection on October 27, 1942, this patient developed a penile lesion. A darkfield examination was positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

Arsenical treatment began with a 0.06-gm. injection of mapharsen on December 9, 1942, followed by 0.03 gm. on December 10, 0.06 gm. on December 11, 0.9 gm. of neoarsphenamine on December 13, and 0.06 gm. of mapharsen on December 15.

One hour after the last injection the patient developed chills, headache, and a temperature of 102° F. Two days later vomiting and a temperature of 104° F. were noted. Three days after the first symptoms, a marked rash appeared over the body. Temperature subsided. WBC 11,550; RBC 5,100,000. Icterus index less than one.

He was given two intravenous injections of 1,000 cc. of 5 percent dextrose and normal saline. All symptoms gradually subsided. Recovery in 16 days.

Case 13-1942.—This patient was exposed to infection on October 7, 1942, and a diagnosis of syphilis was established on presence of a penile lesion, on the inguinal adenopathy, and on a positive darkfield examination on November 1, 1942.

Arsenical treatment began with a 0.02-gm. injection of mapharsen on November 1, 1942, followed by a 0.04-gm. injection on November 5, and 0.06-gm. injections on November 9 and 12.

Two hours after the fourth injection the patient had a chill, and stated that he awakened with a rather severe sore throat. Examination revealed the throat to be very red over the tonsillar area, with streaks. Temperature 103° F. There was an intense papular rash over the chest extending to pubis and into groin. WBC 15,580; RBC 4,570,000. Urine, throat culture, and blood culture negative. Skin showed macular rash without a tendency to produce a diffuse erythema. No Pastia's signs were present in axillae. Rumpel-Leede phenomenon negative.

November 14: Patient improved. Schultz-Charlton reaction and Rumpel-Leede phenomenon negative. Scarlet fever antitoxin, 450,000 units, given.

November 17: Patient given thio-bismol injection in the morning. In the afternoon he complained of acute coryza and generalized muscular aching. Temperature 101.4° F. at 0900. Symptoms have persisted and become more aggravated. Temperature 104.6° F. at 1500.

November 18: To rule out serum sickness, adrenalin and calcium lactate administered. Physical examination reveals a generalized lymphadenitis and an associated acute coryza. Chest is clear. CBC normal. Blood Kahn and urinalysis are negative. Blood sedimentation rate, 20 mm. per 1 hour.

November 20: All medication except local treatment of chancre discontinued. Blood culture is negative.

November 23: Patient complains of photophobia and backache. Atropine and hot compresses applied to left eye.

November 25: CBC and urinalysis both within normal limits. Patient complains of pain in left eye. Injection of ciliary type present. Discharge of pus and mucus is absent. Desquamation of hands and feet.

November 28: Eye slightly improved. Patient has keratitis, dendritic. Hot packs, zinc oxide and yellow oxide of mercury ointment, applied.

November 29: Condition unchanged. Given 20,000,000 typhoid organisms.

December 1: Diagnosis: Poisoning, therapeutic, acute, mapharsen (syphilis).

December 17: Skin condition tested against arsenic. Given 0.01 gm. of mapharsen at 1100. Patient felt chill at 1700. Temperature 99.6° F., pulse 62, respiration 26. Mild rash over chest. Forced fluids. Soda, gr. 30, by mouth. Eye condition worse.

December 26: Returned to duty this date. Recovery in 25 days.

Case 14-1942.—This patient was first infected on January 1, 1938, and was diagnosed by a darkfield examination.

From January 14, 1938, to November 24, 1939, he received 5 injections of neoarsphenamine, 27 injections of mapharsen, 18 injections of bismuth, and mercury inunctions.

On August 29, 1941, he was again admitted to the sick list with syphilis which was apparently considered to be a new infection. From August 30, 1941, to March 10, 1942, he received approximately 14 injections of mapharsen.

Three hours after the last injection he developed a slight rash on his thighs which disappeared within 3 days. This was reported to the medical officer and he was given another injection of mapharsen. About 2 or 3 days later, a rash developed on his thighs and hands. This condition persisted but a report to the medical officer was not made until 10 days later, at which time the rash appeared to be fading somewhat. Examination revealed erythematous dermatitis on the anterior surface of both thighs and a generalized dryness of all skin surfaces. Treatment consisted of calamine lotion applications and a slow improvement was shown. In view of patient's inability to tolerate mapharsen, and his need for further antiluetic treatment, he was transferred to a naval hospital. While under treatment for the reaction it was discovered that the patient had tuberculosis. The diagnosis was changed to tuberculosis, chronic, active, and the patient was invalidated from the service.

Case 15-1942.—This patient was exposed to infection on August 19, 1942. A diagnosis of syphilis was established on October 23, 1942, by finding the typical motile treponema in the exudate from mouth lesion on darkfield examination. Also showed a positive Kahn blood reaction of 1-plus on October 23, a 3-plus on October 24, and 4-plus on October 25 and 29.

Arsenical treatment began with a 0.03-gm. injection of mapharsen on October 23, 1942, followed by 0.06-gm. injections on October 25, 29, and November 5.

Two hours after the 4th injection he noticed that his eyes were quite "blood-shot". About an hour later he began to feel sick, and had a "stomach ache," chills, and headache lasting about 1½ hours. One hour later he noticed that the skin on his forearms, arms, and upper part of the body was blotchy red. He

did not report for treatment until several hours later (about 8 hours after the last injection).

At the time of admission to the sick list on November 5, his temperature was 102° F.; pulse 90; respiration 22. Physical examination revealed marked injection of conjunctiva, ocular and palpebral, blotchy nonraised erythema of face, forearms, arms, chest, back, abdomen, and thighs, distended abdomen, and slight nausea. No bowel movement for 4 days.

Immediate treatment consisted of sodium thiosulfate, gm. 1, intravenously; forced fluids; sodium bicarbonate enema; sodium amytal gr. 3; ephedrine sulfate gr. $\frac{3}{4}$, hypodermically; calcium lactate gm. 2; ephedrine hydrochloride gr. $\frac{3}{4}$, orally.

Temperature rose to 104° F., pulse 130, and respiration 40 during the night. The following day the patient was considerably better. Abdominal distention, erythema, and temperature subsided. RBC 5,060,000; WBC 5,400. All symptoms gradually subsided under treatment. Recovery in 4 days.

Case 16-1942.—This patient was hospitalized for an appendectomy. A routine serologic test taken on March 20, 1942, revealed a completely positive Wassermann and Kahn. These tests were repeated on March 24 and 30, and again were completely positive. There was no clinical evidence of syphilis, no neurologic, cardiac, psychiatric, visceral, bone, or skin abnormalities.

Antiluetic treatment began with 0.06-gm. injections of mapharsen on March 31, April 7 and 14. The day after the last injection the patient awoke with redness, swelling, and itching of left eyelid. Over a period of 24 hours this spread to involve right eyelid and adjacent area on forehead and cheek. Four days later facial lesions began regressing and edema and redness subsided considerably.

A branny desquamation appeared on the face, and large itching erythematous areas containing a few vesicles appeared in each antecubital fossa and nape. Slight oozing was noted on nape the next day.

Boric acid compresses were applied to eye lesions, and calamine lotion to antecubital fossae. All symptoms gradually subsided under treatment. Recovery in 14 days.

Case 17-1942.—After exposure to infection on July 2, 1941, this patient was given a diagnosis of syphilis because of a positive darkfield examination.

From July 3, 1941, to May 21, 1942, he received 3 courses of mapharsen, a total of 1.71 gm., and from August 28, 1941, to June 11, 1942, 3.12 gm. of bismuth as concurrent treatment.

Twenty-five days after the last injection of mapharsen, on May 21, 1942, an arsenical reaction occurred. Marked inflammation of the skin about both ankles and over the lower one-third of the legs was noted and resulted in desquamation, weeping, and marked reddish discoloration of the affected areas. A rough, branny, itching dermatitis, which did not weep, occurred over the back. There were no constitutional symptoms.

Treatment consisted of local boric acid soaks and rest in bed. Recovery in 40 days.

SUMMARY

In 1942, medical officers of the Navy administered 122,106 doses of arsenicals and reported the occurrence of 35 reactions therefrom. Of these reactions 17 were arsenical dermatitis; a ratio of one case of dermatitis to 7,183 doses. Of interest in connection with the etiology of arsenical dermatitis is the number of instances in which

premonitory signs were noted. These signs are repeated below and serve to indicate the necessity for careful examination and questioning of each patient before administering an arsenical.

Case 5.—A slight reaction occurred after the first injection of the second course of mapharsen. Four months later an erythematous eruption with headache, abdominal pain, general malaise, and fever followed an injection of mapharsen.

Case 7.—A mild macular rash developed after the second injection of mapharsen. The rash reappeared following the third injection given 2 days later.

Case 9.—After the first injection of neoarsphenamine the patient developed a Herxheimer effect with chills, and temperature of 103° F. The same symptoms accompanied by a generalized erythematous macular eruption developed after the third injection given 1 week later.

Case 11.—An exfoliative dermatitis developed after 18 injections of mapharsen had been administered. The first signs and symptoms of this reaction occurred about 3 months after treatment was begun and increased gradually during the last 8 to 10 weeks. It is believed that this reaction was caused by accumulative poisoning due to repeated injections of mapharsen and not due to any 1 injection.

Case 14.—An unreported rash developed after the 14th injection of mapharsen. An erythematous dermatitis developed after the 15th injection and was not reported until 10 days later.

LEAD POISONING AS A CLINICAL ENTITY DURING THE RECONDITIONING OF WARSHIPS ¹

FRANKLYN D. HANKINS

Lieutenant Commander (MC) U. S. N. R.

This ship received serious damage during an enemy attack, so much so that all power-operated machinery was put out of commission nearly every compartment was flooded with fuel oil and water, and in many areas fire contributed to the destruction.

At a certain stage in the repair of the structural damage, our men were assigned the arduous task of removing the ship's paint. This oil-coated paint was of varying degrees of thickness; in some areas accumulated layers of repeated painting were present. This was scaled with the power-operated chipping hammers and then smoothed off, using a rotary wire brush. After six weeks of work our first case of acute lead poisoning developed.

Approximately 600 men were engaged in the paint removal program, of whom 28 developed the clinical syndrome of plumbism before the conditions responsible were controlled. These 28 cases presented the gastro-intestinal symptoms typical of lead poisoning, the symptoms varying in degree from moderately severe to severe. In the latter

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group were 7 patients requiring hospital treatment. No deaths occurred and to date no case has progressed into the chronic form of the disease. The clinical diagnosis was supported in each case by laboratory finding of abnormal blood lead and urinary lead levels, and the presence of stippling in a significant percentage of the red blood cells.

Experience indicates that on board naval vessels, where extensive paint removing programs are launched, it is not beyond the realm of possibility that a fair proportion of the crew may be disabled with consequent loss of fighting efficiency. Consequently, shortly after the malady was ascertained to be lead poisoning, it was decided to determine what proportion of the men had received toxic doses of lead as a result of their work. For this purpose we selected certain individuals from the various divisions who had not been ill or complained of symptoms, but who had at the time worked continuously for at least six weeks. Chemical analyses for blood lead and the lead content in the 24-hour urine were made. In every case so tested, the results revealed concentrations of lead in both blood and urine far in excess of those found in the normal controls. The control group was composed of Navy personnel who had not been exposed to lead dust, but otherwise lived under identical conditions. The results are given in table 1.

TABLE 1

	Blood lead (average)	Urine lead (average)
Exposed group (asymptomatic).....	1.07 mg. per liter.....	0.265 mg. in 24 hours.
Control group (not exposed to lead).....	0.30 mg. per liter.....	0.03 mg. in 24 hours.

In table 2, the average blood and urinary lead levels of the test group, composed of asymptomatic individuals selected at random from the crew are compared with those found in men who developed the disease.

TABLE 2

	Blood lead (average)	Urinary lead (average)
Exposed group (asymptomatic).....	1.07 mg. per liter.....	0.265 mg. in 24 hours.
Lead poisoning (28 cases).....	1.59 mg. per liter.....	0.293 mg. in 24 hours.

These findings were interpreted as indicating that a large proportion of our crew were receiving toxic doses of lead, also that the usual control measures were inadequate, and that a more effective prophylactic program is needed in order to protect men so employed.

A review of the available literature revealed that this same difficulty has been previously encountered by others in the naval service. Pitt (1) reported three cases of lead encephalopathy in men doing this work. Hamilton (2) makes mention of a large number of cases which developed in the Brooklyn Navy Yard some years ago, and Potter (3) reports a similar outbreak at the Puget Sound Navy Yard. Because plumbism has resulted in much loss of time and efficiency in the various industries where workmen are exposed to lead, much attention has been given to its cause and prevention by research workers as well as by the industrial surgeon. Most investigators agree with Goadby (4) that lead poisoning is for the most part caused industrially by the inhalation of lead dust. This is true because, as was pointed out by Hamilton, lead absorbed through the lungs enters the general circulation directly and is more promptly distributed throughout the organism than that absorbed into the portal system from the gastro-intestinal tract. This is somewhat in conflict with the generally held opinion that ingestion of lead products or their absorption through the skin is of foremost importance in producing lead poisoning. In fact these latter two avenues of entry, in the light of repeatedly recorded experience in the lead industries, appear to play only a minor part in the production of this disease.

Our experience has given us the impression that, generally speaking, those engaged in the repair or reconditioning of naval vessels fail in some respects to appreciate the risk to health involved in the removal of paint by power-chipping hammers and wire brushes and in the cutting of paint-coated metal with the oxyacetylene torch. This results in failure to promulgate and enforce adequate control regulations for the effective prevention of plumbism. This is true in part, because the relative importance of the various avenues for the entry of lead into the body is not generally understood. Our men for the most part were cooperative in personal hygiene, i. e., daily change of clothing, bathing immediately after work, and in avoiding the contamination of food or tobacco with paint products from the hands; however, at the same time, few had any conception of the danger involved in the breathing of lead-contaminated air.

In order to obtain a better understanding of this disease and of its prevention, and to evaluate the actual conditions our men are working in, assays were made for atmospheric lead content in many different compartments under a variety of conditions. Many tests were run over a period of five months; a few are reproduced herewith as representative of the findings.

TABLE 3

The following concentration of lead was found in and around areas in which wire brushing and burning operations were being carried out. Ventilation was poor and of the supply type:

Sample No.	Volume of air sampled	Concentration of lead	Sample No.	Volume of air sampled	Concentration of lead
	<i>Cubic feet</i>	<i>Mg. per cu. ft.</i>		<i>Cubic feet</i>	<i>Mg. per cu. ft.</i>
1.....	18	7.00	3.....	18	2.2
2.....	30	3.70	4.....	18	.4

TABLE 4

Atmospheric lead determinations were made under conditions similar to those listed in table 3, with the exception that exhaust type ventilation was provided.

Sample No.	Volume of air sampled	Concentration of lead	Sample No.	Volume of air sampled	Concentration of lead
	<i>Cubic feet</i>	<i>Mg. per cu. ft.</i>		<i>Cubic feet</i>	<i>Mg. per cu. ft.</i>
1.....	45	0.362	3.....	45	0.00
2.....	45	.011	4.....	51	.00

EXPLANATORY NOTES, TABLES 3 AND 4

Samples No. 1.—Taken in compartment No. A-358. Two men were removing dry paint from the bulkheads, using power revolving wire brushes. Paint chips and dust were 1 to 2 inches in depth upon the deck.

Samples No. 2.—Taken in passageway leading from compartment No. A-358, approximately 20 feet from the wire brushing.

Samples No. 3.—Taken in passageway approximately 30 feet from the wire brushing.

Samples No. 4.—Taken in passageway approximately 50 feet from the men working in compartment No. A-358.

The marked reduction of lead-laden dust from the air brought about by exhaust-type ventilation is well illustrated by a comparison of the concentrations found in tables 3 and 4. The relatively high concentrations found at some distance from the actual field of operation is of practical importance because men will persistently remove their respirators in such places. These results also indicate that supply-type ventilation is inadequate as a dust-control measure and may actually do more harm than good, in that it may only serve to circulate collections of dust already present.

Many times an entire compartment is chipped and wire-brushed before the paint chips, dust, and debris are removed from the deck. It is not uncommon to observe as much as 1 or 2 inches of paint dust in such areas. Much dust can be observed being thrown into circulation when the exhaust air from the pneumatic tools impinges upon such accumulations. The sweeping down of the compartment prior to beginning each day's work and the provision of a moist cloth under each worker effectively overcomes this source of trouble. A section of burlap or old canvas which can be easily moistened in water and spread

upon the deck is inexpensive and quite effectively traps whatever chips fall upon it.

In an attempt further to decrease the amount of finely divided dust thrown into the air by the power brushes, we experimented with various means of wetting down surfaces to be cleaned. The observations of Stone (5), medical officer of another ship undergoing repairs similar to ours, are of interest. The routine aboard his vessel was to remove the oil and debris from the painted surfaces by means of live steam and certain hot solutions prior to the actual removal of the paint. This resulted in the paint becoming thoroughly moistened, and unquestionably reduced the production of lead dust in the atmosphere. We are in agreement with him that the use of live steam is most effective, but it has certain disadvantages in application. A simple and quite effective procedure is to spray the bulkheads with water, using an ordinary hand-operated insect type sprayer prior to and during the removal of paint. The addition to the water of a detergent appears to facilitate the more effective wetting of the painted surfaces. In order to evaluate the effect of these control measures, compartments of the ship were set up in such a manner that the dust-producing factors could be controlled. The variables were: Accumulations of paint dust upon the decks; ventilation; moistened cloths to cover the decks beneath the operators, and the provisions of suitable sprayers to wet down the surface to be cleaned of paint. The results of this experiment are given in table 5.

TABLE 5

Sample No.	Lead concentration	Exhaust ventilation	Deck	Surface	Moist cloth on deck
	<i>Mg. per cu. ft.</i>				
1	7.000	Absent.....	Dirty.....	Dry.....	None.
2	0.187	Present.....	do.....	do.....	Do.
3	.173	do.....	do.....	do.....	Do.
4	.127	do.....	Clean.....	Wet.....	Present.
5	.119	do.....	do.....	do.....	Do.
6	.110	do.....	do.....	do. ¹	Do.

¹ Detergent added to water in sprayer.

Sample No. 1, table 5, reveals the atmospheric lead concentrations to which personnel may be subjected during the removal of paint with power equipment. The reduction of air-borne lead brought about by the application of these principles would appear to be effective as evidenced by the results found in test samples 2, 3, 4, 5, and 6. These results indicate that the most important factor in the reduction of lead concentrations is adequate exhaust type ventilation. However, it should be pointed out that it is not always possible to bring about such marked reductions by ventilation alone; this is illustrated by comparing sample 1 of tables 3 and 4, the reduction in that instance being

from 7 mg. per cu. ft. of air to 0.362 mg. per cu. ft. upon the addition of exhaust ventilation. It seems apparent that ventilation is not the entire answer to the problem, because, even at best, the lead concentrations remaining are at a dangerous level and the importance of the additional control measures should not be underestimated.

Since we were not able to produce an ideal condition by dust control methods alone, the importance of an efficient respirator is apparent. The question may fairly be asked, Why attempt reduction of dust concentration if it cannot be reduced to such a level that would make the use of a respirator unnecessary? The answer is, The respirators we use at present give only partial protection. A certain amount of leakage occurs about the face piece, as evidenced by the observation that after a respirator has been in use a short time in a dusty atmosphere, a coating of dust will be seen inside of the face piece, its depth depending upon the amount of leakage and the intensity of dust concentration in the surrounding air. Secondly, we believe the efficiency of our present respirators decreases materially with increased dust concentration. It is, therefore, necessary to reduce the amount of dust in the surrounding air in order for the respirator to afford maximum protection to the wearer.

CONCLUSION

The fact that lead poisoning occurs with far greater rapidity and intensity from inhalation of lead-contaminated air than from the ingestion of lead products is of practical importance in the control of this disease. Our experience bears out the observation of Hamilton that there can be no effective control of plumbism unless it is based upon keeping the air clear of lead-laden dust and fumes. In fact, new cases of lead poisoning continued to develop on this vessel until the problem was approached in that manner.

Our crew has been engaged in the removal of the ship's paint over a period of 10 months. The first case developed in a man who had been chipping and wire-brushing for a period of only 6 weeks. This man had not worn the respirator with which he had been provided. Subsequent cases continued to develop until such a time as the above-mentioned control measures were actually practiced. This required the active cooperation of all division and petty officers as well as the men so employed. Since that time no case has developed, even though the same men have been at this work during a prolonged period. We believe this demonstrates that lead poisoning can be prevented aboard ships by the intelligent application of existing principles for its control.

The following is suggested for the regulation of those activities in which the men are exposed to toxic concentrations of lead:

1. All men engaged in the operation of spray-type paint gun, power-chipping hammers, wire brushes, and oxyacetylene burners will wear approved type respirators at all times. Other personnel who may be assigned tasks in closed compartments or passageways, in or adjacent to where these operations are under way, will also wear respirators.
2. In closed compartments, exhaust-type ventilation shall be provided.
3. The decks shall be kept clean of paint dust and debris and covered with a suitable wet dropping cloth.
4. All surfaces shall be wet down with water spray prior to and during chipping and wire-brushing operations.
5. A clean work suit will be issued daily. The work suit will be turned in for laundry at the close of the day.
6. A soap and water shower will be taken each day as soon as practicable after knocking off work. Each man will then change to clean clothing (including underclothing).
7. The hands will be thoroughly washed and cleaned before meals, special care must be given to keeping the nails short and clean, in order to avoid contaminating the food with particles of paint.
8. Hands contaminated with paint or paint particles must be kept away from the mouth. Tobacco must be protected in order that it does not serve to transfer paint products into the mouth.
9. All hands should avail themselves of the opportunity to drink milk with meals when it is available.

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HAZARDS OF TETRACHLORETHANE ON SHIPBOARD:

A CASE REPORT OF ACUTE NARCOSIS

NATHAN H. FRIEDMAN

Lieutenant (MC) U. S. N. R.

Prior to the occurrence of this case of acute narcosis due to tetrachlorethane, I was neither fully aware of the toxicity of the substance, nor of the seriousness of the complications which could have resulted. Since this case has occurred, I have spoken to colleagues on other ships regarding the hazards of tetrachlorethane and most of them have been unfamiliar with the substance.

Tetrachlorethane ($\text{CHCl}_2\text{--CHCl}_2$) is a chlorinated hydrocarbon of the ethane series and has a boiling point of 146.3°C. , at 760 mm., and a specific gravity of 1.595 at $20^\circ/4^\circ \text{C.}$ (1). The liquid is considered noninflammable and nonexplosive under Bureau of Explosives regulations. It possesses an odor not unlike ethyl chloride and chloroform, but a trifle sweeter and more pungent. At ordinary temperatures it is slightly volatile. It is used primarily as a solvent for organic substances.

Many cases of chronic poisoning from tetrachlorethane have been reported in literature, but few cases of acute poisoning causing narcosis have been described. The toxic effects in man are produced principally by the inhalation of the vapor, by absorption through the skin, and rarely by drinking the liquid. The former is the most common route, but Schwander (2) and Burgi (3) have shown that sufficient quantities may be absorbed through the skin to produce complete narcosis. The excretion of the substance is mainly by the lungs.

In the acute cases it acts by depressing the nervous system, causing narcosis and death by respiratory paralysis (4). In this respect it is thought to be about four times more active than chloroform (5). On isolated frog heart it has been shown to possess a toxic action six times that of chloroform (6). In the cases of chronic poisoning the substance has a particular avidity for producing changes in the liver, kidneys, peripheral nerves, and blood picture. Individual susceptibility is variable. In the industries in which it is still used, workers who have had slight attacks and return to work are especially susceptible (7). A second attack often develops rapidly, terminating in death. Characteristic changes in the blood picture as described by Parmenter (8), Minot and Smith (9), may appear even when the symptoms are vague and indefinite.

Lehmann and Schmidt-Kehl (10) conducted experiments on medical students in a room, 10 cu. m. in size, in which the concentration

¹ Received for publication June 26, 1943.

of the vaporized poison fell only 10 percent in 30 minutes. The poison was distributed uniformly in the room by expert spraying. The poisonous content of the air in the room was determined analytically beforehand and then the expired air was analyzed. The concentration was from 20 to 89 mg. per liter. The students showed slight or serious symptoms depending on the degree of concentration. These symptoms were a feeling of pressure in the head, formication, dizziness, a diminution of will power, hazy vision, ringing in the ears, sweet taste on the lips, a desire to shake hands and swooning sensation. Loss of consciousness occurred after one minute at a concentration of 89 mg. per liter. Pressure in the head persisted for 2½ hours in those that inhaled vapors at a concentration up to 89 mg. per liter. Concentrations causing resting, light and deep narcosis are but finely separated.

Hepple (11) and Elliott (12) have reported cases which showed acute narcotic effect with death occurring before liver injury could be produced. Both of these cases were due to drinking "Silk Cleansing Fluid," later proved to be tetrachlorethane. Both men became unconscious. Cyanosis with loss of corneal reflexes set in, quickly followed by death 8 and 12 hours later. Postmortem examination showed hyperemia of the gastric mucosa, slight congestion of the kidneys and acute congestion of the lungs. In Hepple's case, congestion and cloudy swelling of the liver were also present.

In the Navy, tetrachlorethane is used as a solvent for organic substances in the impregnation of gas protective clothing. The product is supplied by the manufacturer in metal drums containing 65 pounds of the liquid, and on each drum is printed this pertinent advice:

Tetrachlorethane may be used with safety in properly designed and maintained equipment if the following precautions are observed:

1. Use with adequate ventilation.
2. Avoid breathing the vapor.
3. Avoid contact with the skin.
4. Do not take internally.

On board ship tetrachlorethane was stored in the gas mask storeroom. This space is on the second platform deck, below the steering engine room. The dimensions of this storeroom are 4½ feet from the keel to the overhead, and it forms part of the bilge of the ship. It is 22 feet in length and 7 feet in width. This space was also utilized for the storage of engineering spare-parts boxes.

During a period of rough weather the bung of one of the metal drums was broken away from its soldered base, allowing approximately 45 pounds of the volatile fluid to escape and diffuse throughout the space, causing a high concentration of the vapor to be present.

Approximately 72 hours after the rough weather above mentioned, an electrician had occasion to enter the hold for a spare part and was

ing is the statement of the asphyxiated man :

I entered and left the hold three or four times before I was overcome. After entering the third or fourth time I was determined not to leave until I had obtained the spare parts that I needed. The possibility of being overcome by the fumes had entered my mind, therefore I asked two or three of the men nearby to keep an eye on the hold and to come in after me if I did not reappear within a reasonable length of time. A few strong whiffs had made me a little dizzy, and as I approached the spare-parts box the dizziness grew worse. After reaching into the box and checking the numbers of the parts, I was unable to locate those I wanted. By this time I was ready to give up and leave the hold for a breath of fresh air. It seemed that my desire for fresh air was caused more by the penetrating odor of the fumes than by the feeling of dizziness or sleepiness. In fact, I don't recall feeling drowsy at any time prior to being overcome. The last I remember is that I reached for a tube and did not find it to be the one for which I was searching. I started to replace the tube in the spare-parts box, but was overcome. It was my belief that I had spent not more than 5 minutes in the hold when this occurred, but from information given me later by one of the men standing by, I had been in the hold for 20 to 30 minutes before being removed by them.

The asphyxiated individual was brought topside immediately and given first aid, recovering consciousness in 8 minutes. When first seen by a member of the medical department he resembled an individual in the first plane of third stage general anesthesia. His breath and clothing reeked with an odor similar to that of ethyl chloride. His skin had a canary yellow pallor somewhat like that seen in patients with pernicious anemia. Cyanosis was not present. His respiratory rate was 18, regular and quiet. The eyeballs were fixed and the pupils contracted. The pulse rate was 100, regular and of good quality.

After the narcotized individual regained consciousness he developed a "laughing jag" which lasted 10 minutes. He stated that he felt as if he had been drinking. When consciousness was fully regained he attempted to walk but staggered and had to be carried to the sickbay. In an hour he appeared normal except for muscular weakness and the persistence of slight pallor. He ate his usual lunch and stated that he felt well that afternoon. Further complications did not develop. A microscope for studying the blood changes was not available.

I ventured into the hold the same day for an exposure lasting 5 minutes. The first symptom to develop was a feeling of warmth, followed by tingling and burning of the skin. Then the temporal pulses began to pound and vertigo developed. The pulse rate, which was 72 at the onset, rose to 100, and was full and bounding in character. At this point I left the hold, feeling weak and unsteady. After a few minutes topside all the symptoms disappeared.

Since the vapor is six times heavier than air and insoluble in water, the ventilation of the hold had not been completely accomplished.

The persistence of the vapor in the storage space, despite repeated blowing, sucking, and washing procedures, may be attributable to the design of the compartment which has only one entrance and no blower vents. Possibly the absorption of the tetrachlorethane by the paint on the skin of the ship is partly responsible for this inherent difficulty.

It seems advisable to make the following recommendations for the prevention of similar accidents on shipboard:

1. The hazards of tetrachlorethane should be more fully promulgated among the naval personnel.
2. Gas-protective clothing already impregnated and drums containing tetrachlorethane should be stowed in compartments which are well ventilated.
3. It is recommended that this substance be supplied in smaller and sturdier drums for shipboard stowage.
4. If practicable a less toxic organic solvent for the impregnation of gas-protective clothing should be substituted.

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POISON IVY IMMUNIZATION

Fluid extract of *Grindelia robusta* in ten-drop doses three times a day for successive days in March produced immunization which remained for at least a year. Many of the individuals took the treatment annually for many years and conclusions are based on the fact that none of them ever developed ivy poisoning.

Grindelia has considerable use as a local application in the treatment of rhus poisoning.—Kentucky M. J. 41:258, August 1943.



TREATMENT OF BURNS IN RUSSIA

Many burns are now being covered with a layer of pine sawdust and then bandaged. This material is being used (1) because it is plentiful, and (2) because of its apparently beneficial local influence, i. e., it seems to exert an absorptive, cushioning, and antiseptic effect.—Elman, R.: Russian war surgery; military medical reports from Russia. Surg., Gynec. & Obst. 77: 93-97, August 1943.



INGUINAL HERNIA

Halsted quotes Shuh thus: "If no other field were offered to the surgeon for his activity than herniotomy, it would be worth while to become a surgeon and to devote an entire life to this service." This is doubtless true, because herniae are among the most common ailments of humanity.

Statistical observations made in our laboratory (Novak) indicate that slightly more than one-third of the white male adult cadavera, and a little less than one-fourth of the white females, have a peritoneal diverticulum or sac at the internal ring. These sacs vary from 2 mm. to 5 mm. in diameter and from $\frac{1}{2}$ cm. to 7 cm. long. Negro cadavera give less evidence of these sacs.—Job, T. T.: Inguinal hernia; some phases of the anatomy of inguinal herniae. Clin. Med. 50: 187-188, July 1943.

STATISTICS

HEALTH OF THE NAVY

The statistics (annual rates per 1,000) appearing in this summary were compiled from data contained in monthly reports of communicable diseases received in the Bureau for the months of April, May, and June, 1943.

ENTIRE NAVY

Year	All diseases	Injuries and poisonings	All causes	Communicable diseases		Venereal diseases
				A	B	
1938-----	331	50	382	9	79	78
1939-----	339	48	387	7	85	90
1940-----	431	51	482	48	118	83
1941-----	413	47	461	47	118	51
1942-----	411	48	459	44	137	39
1943-----	479	47	526	46	181	28

FORCES ASHORE

1938-----	364	51	415	15	105	45
1939-----	332	48	380	12	104	41
1940-----	446	53	498	43	144	52
1941-----	476	48	524	72	152	36
1942-----	427	45	472	50	151	25
1943-----	508	46	554	54	199	23

FORCES AFLOAT

1938-----	313	50	363	5	64	96
1939-----	343	47	391	4	75	117
1940-----	420	50	470	52	99	105
1941-----	358	46	404	25	89	65
1942-----	374	54	429	32	108	71
1943-----	373	51	423	18	114	47

DISABILITIES OR DISEASES CAUSING SEPARATION FROM THE SERVICE

The following table was prepared from reports of medical surveys received in the Bureau during May and June 1943, in which disabilities or diseases causing separation from the service existed prior to entry into the Navy.

Cause	Num- ber of medical surveys	Cause	Num- ber of medical surveys
Abscess, Bartholin gland	1	Avulsion, insertion biceps fe- moris	1
Abscess, ischiorectal	1	Bromidrosis	1
Abscess, lung	1	Bronchiectasis	29
Abscess, periapical	5	Bronchitis, chronic	22
Absence, acquired, coccyx	1	Bursitis, chronic	6
Absence, acquired, gallbladder	1	Calculus, kidney	5
Absence, acquired, kidney	2	Calculus, renal	1
Absence, acquired, teeth	72	Callosity	1
Absence, congenital, left pec- toralis major muscle	1	Cardiac arrhythmia, auricular fibrillation	4
Absence, congenital, kidney	1	Cardiac arrhythmia, heart block	2
Accessory ribs	2	Cardiac arrhythmia, paroxys- mal tachycardia	6
Acne, cystic, face	1	Cardiac arrhythmia, prema- ture contractions	3
Acne vulgaris, face	2	Cardiac arrhythmia, sinus ar- rhythmia	1
Acrocyanosis	1	Cardiac disorder, functional	3
Addison's disease	1	Caries, teeth	27
Adherent retroversion, uterus	2	Carotid sinus syndrome	1
Adhesions, abdominal	1	Cataract	13
Adhesions, right lower quad- rant	1	Cellulitis	1
Albuminuria	25	Cerebral syndrome, post-trau- matic	1
Alcoholism, chronic	19	Cerebrospinal syphilis, un- differentiated	6
Allergy, nasal	4	Cholecystitis, chronic	4
Allergy, skin	5	Cholelithiasis	2
Allergy, unclassified	1	Chondromalacia	1
Allergy, vasomotor, rhinitis	1	Chorea, chronic	1
Amblyopia	88	Chorioretinitis	23
Amblyopia, ex anopsia	11	Choroiditis	5
Amnesia	2	Cicatrix, skin	3
Amputation, traumatic	1	Cirrhosis, liver, atrophic	1
Anemia, pernicious	1	Coarctation of aorta	1
Anemia, sickle cell	3	Colitis, chronic	9
Angina pectoris	1	Colitis, ulcerative	2
Angioneurotic edema	1	Color blindness	8
Ankylosis	6	Compression fracture, verte- brae	1
Aphakia	2	Conduction defect, right bun- dle branch block	1
Arteriosclerosis, cerebral	3	Conjunctivitis, vernal	1
Arteriosclerosis, coronary	1	Constipation	1
Arteriosclerosis, general	18	Constitutional psychopathic inferiority without psychosis	104
Arteriosclerosis, legs	1	Constitutional psychopathic state, criminalism	3
Arteriosclerosis, right tibial artery	1	Constitutional psychopathic state, emotional instability	384
Arthritis, acute	1	Constitutional psychopathic state, inadequate personality	252
Arthritis, chronic	238	Constitutional psychopathic state, paranoid personality	17
Arthritis deformans	4	Constitutional psychopathic state, schizoid personality	103
Astigmatism, compound hyper- peropic	10	Constitutional psychopathic state, sexual psychopathy	22
Astigmatism, compound myo- pic	16	Contracture	3
Astigmatism, mixed	6	Coronary heart disease, arteri- osclerotic	18
Astigmatism, simple hyper- opic	4		
Astigmatism, simple myopic	6		
Ataxia, hereditary	1		
Atelectasis	1		
Athetosis	1		
Atony, anal sphincter	1		
Atrophy, leg	9		
Atrophy, muscle, hand	1		
Atrophy, optic nerve	2		
Atrophy, shoulder girdle and arm	1		

Cause	Num- ber of medical surveys	Cause	Num- ber of medical surveys
Cryptorchidism	7	Endocrinopathy, infantilism	1
Curvature, spine	12	Endocrinopathy, skeletal	1
Cyst, femur	2	Enterocolitis, chronic	1
Cyst, lung	3	Enuresis	74
Cyst, multilocular	1	Epidermolysis bullosa	3
Cyst, ovarian	21	Epididymitis, chronic, nonve- neral	1
Cyst, pericardial	1	Epilepsy	184
Cyst, pineal gland	1	Epilepsy, Jacksonian	1
Cyst, synovial, left popliteal space	1	Epiphora	1
Cyst, teratoma, mediastinal	1	Epiphysiolysis, right	1
Cyst, thyroglossal	2	Epiphysitis, dorsal spine	1
Cystitis, chronic, nonvenereal	1	Epiphysitis, head right femur	2
Dacryocystitis	1	Epiphysitis, lumbar spine	2
Deafness, bilateral	66	Epiphysitis, vertebra	3
Deafness, unilateral	27	Epithelioma	1
Defective physical develop- ment	5	Fibromyoma, corpus uteri	2
Deformity, acquired	209	Fibrositis, chronic	1
Deformity, congenital	107	Fistula in ano	1
Dementia paralytica	4	Fistula, urethral	1
Dementia praecox	189	Fistula, urinary, perineal	2
Dementia pugilistica	1	Flat foot	276
Dermatitis, atopic	6	Focal infection, teeth	2
Dermatitis, contact (cause un- known)	1	Foreign body, traumatic	4
Dermatitis venenata	3	Fracture, simple	9
Detachment, retina	4	Fungus infection, skin	1
Deviation, nasal septum	2	Gastritis, chronic	18
Diabetes mellitus	17	Gastroduodenitis	2
Diabetes insipidus	1	Gastro-enteritis	1
Dislocation, articular cartilage	17	Gastro-enterostomy	1
Dislocation, chronic recurrent	34	Genu valgum	1
Dislocation, head of radius	1	Glaucoma	3
Dislocation, hip, congenital	2	Glycosuria	2
Dislocation, intervertebral disc	1	Goiter, simple	1
Dislocation, semilunar bone (wrist)	1	Gonococcus infection, cervix	2
Dislocation, semilunar cartilage	1	Gonococcus infection, joint	1
Dislocation, 5th lumbar spine and 1st sacral segment	1	Gonococcus infection, prostate	11
Diverticulum, duodenum	3	Gonococcus infection, urethra	1
Diverticulosis, intestinal	3	Gout, acute	1
Drug addiction, barbiturates	1	Gout, chronic	1
Drug addiction, mariahuana	1	Hallux valgus	11
Duodenitis	11	Hammertoe	6
Dysidrosis	1	Hay fever	4
Dysmenorrhea	3	Headache	23
Dyspepsia, functional	3	Heart disease, congenital	13
Dyspituitarism	2	Hemangioma	5
Dysplasia, spinal cord	1	Hematoma, subdural	1
Dystrophy, progressive muscu- lar	6	Hemichoreo-athetosis	1
Eczema	12	Hemiplegia, old	2
Effort syndrome	22	Hemophilia	1
Elephantiasis, nonfilarial	1	Hemorrhage, subdural	1
Emphysema, pulmonary	3	Hemorrhoids	1
Encephalitis, chronic	6	Hereditary hemorrhagic dia- thesis	1
Encephalopathy, post-trau- matic	1	Hernia, bilateral, recurrent, di- rect	1
Endocarditis, chronic	2	Hernia, epigastric	1
		Hernia, inguinal, direct	1
		Hernia, inguinal, indirect	54
		Hernia, intervertebral disc	1

Cause	Number of medical surveys	Cause	Number of medical surveys
Hernia, muscle.....	1	Myopia.....	64
Hernia, recurrent, after operation.....	1	Myositis, chronic.....	60
Hernia, traumatic.....	7	Myositis, progressive, ossifying.....	1
Hernia, ventral.....	1	Narcolepsy.....	2
Hidradenitis suppurativa.....	1	Necrosis, aseptic, femur.....	1
Hodgkin's disease.....	1	Neoplasm, pericardial.....	1
Hydrocele, spermatic cord.....	1	Nephritis, chronic.....	18
Hydronephrosis.....	11	Neuralgia.....	1
Hydro-ureter.....	1	Neuritis, brachial plexus.....	3
Hyperchlorhydria.....	1	Neuritis, dorsal nerve.....	1
Hyperhidrosis.....	1	Neuritis, femoral, left.....	1
Hyperopia.....	7	Neuritis, multiple.....	3
Hypertension, arterial.....	91	Neuritis, optic.....	5
Hypertensive heart disease.....	9	Neuritis, sacral plexus.....	1
Hyperthyroidism.....	9	Neuritis, sciatic.....	10
Hypertrophy, heart.....	6	Neuritis, ulnar nerve.....	1
Hypochondriasis.....	3	Neuroma.....	1
Hypopituitarism.....	1	Neuroretinitis.....	1
Hypothyroidism.....	3	Neurosis, cardiac.....	1
Ichthyosis.....	1	Neurosis, eye.....	1
Immature personality.....	1	Neurosis, gastric.....	15
Incontinence, anal.....	1	Neurosis, gastro-intestinal.....	2
Incontinence, urine.....	1	Neurosis, intestinal.....	4
Insufficiency, ocular muscle.....	2	Neurosis, stomach.....	1
Intracranial injury, old.....	56	Neurosypilis, serological.....	2
Iridocyclitis.....	1	Night blindness.....	1
Irritable carotid sinus.....	1	Nystagmus.....	2
Irritable colon.....	6	Obesity.....	1
Iritis.....	1	Obstruction, intestinal.....	2
Joint, internal derangement of.....	88	Opacity, cornea.....	4
Keratitis.....	5	Ophthalmoplegia.....	1
Keratoconus.....	1	Organic brain disease without psychosis.....	1
Keratoderma.....	2	Osgood-Schlatter disease.....	6
Keratosis.....	4	Osteoarthropathy, hypertrophic.....	9
Keratosis, follicularis.....	1	Osteochondritis deformans.....	10
Laryngitis, chronic.....	3	Osteochondritis dissecans.....	20
Lichen planus.....	2	Osteochondritis, post-traumatic.....	1
Loose body in joint.....	11	Osteochondroma, tibia.....	1
Loss of substance of bone.....	4	Osteochondroma, femur.....	2
Lupus erythematosus.....	4	Osteochondromatosis.....	2
Lymphangiectasis.....	1	Osteoma.....	1
Lymphangitis.....	1	Osteomyelitis, chronic.....	10
Lymphogranuloma venereum.....	1	Osteomyelitis, nasal bones.....	1
Lymphoma, mediastinal.....	1	Otitis media, chronic.....	235
Macular degeneration, eye, congenital.....	1	Otosclerosis.....	5
Malaria, type unknown.....	1	Pachymeningitis, cerebral, old.....	2
Malocclusion, teeth.....	3	Pancreatitis.....	1
Mastoiditis, chronic.....	13	Pansinusitis.....	18
Melanoma.....	1	Papilloma, larynx.....	2
Meningitis, cerebrospinal.....	1	Paradentosis.....	9
Menorrhagia.....	1	Paralysis agitans.....	1
Mental deficiency (moron).....	52	Paralysis, brachial plexus.....	1
Metatarsalgia.....	8	Paralysis, nerve.....	9
Migraine.....	35	Paralysis, ocular muscle.....	3
Myasthenia gravis.....	1	Perforated nasal septum.....	12
Myocarditis, chronic.....	20	Periostitis, chronic.....	1
Myofascitis, chronic.....	4	Personality disorder, post-traumatic.....	4
Myoma of uterus.....	3		

Cause	Num- ber of medical surveys	Cause	Num- ber of medical surveys
Personality disorder, post- encephalitic.....	1	Recurrent depression.....	1
Pes cavus.....	12	Regional ileitis.....	1
Phlebitis.....	8	Retinitis.....	8
Pleurisy, fibrinous.....	9	Rheumatic fever.....	62
Pleurisy, serofibrinous.....	3	Rheumatism, muscular.....	11
Pleurisy, suppurative.....	1	Rhinitis, atrophic.....	4
Pneumonia, chronic, inter- stitial.....	1	Rupture, traumatic.....	9
Poisoning, chronic, arsenic.....	1	Rupture, nontraumatic.....	1
Poliomyelitis, anterior, chronic.....	4	Rupture, intervertebral disc.....	2
Polycystic lung disease.....	1	Salpingitis.....	8
Polypus, duodenum.....	1	Schmorl's disease.....	1
Polypus, nasal.....	1	Scleritis.....	1
Postconcussional syndrome.....	1	Sclerosis, disseminated.....	1
Postencephalitic syndrome.....	1	Sclerosis, lateral.....	1
Postural defect.....	2	Sclerosis, lateral amyotrophic.....	1
Prolapse, rectum.....	1	Seasickness.....	17
Prostatitis, chronic, nonvenereal.....	7	Seborrhea.....	1
Protruded intervertebral disc.....	1	Sexual perversion.....	1
Pruritus ani.....	1	Silicosis.....	3
Psoriasis.....	11	Simple adult maladjustment.....	42
Psychoneurosis, anxiety neu- rosis.....	164	Sinus, cervical, branchial, con- genital.....	1
Psychoneurosis, compulsion neurosis.....	5	Sinusitis, ethmoidal.....	4
Psychoneurosis, hysteria.....	105	Sinusitis, frontal.....	11
Psychoneurosis, mixed.....	99	Sinusitis, maxillary.....	12
Psychoneurosis, neurasthenia.....	105	Somnambulism.....	30
Psychoneurosis, post-traumatic neurosis.....	1	Splanchnoptosis.....	1
Psychoneurosis, psychasthenia.....	6	Spondylitis.....	7
Psychoneurosis, situational.....	10	Spondylolisthesis.....	13
Psychoneurosis, traumatic.....	14	Sprain, joint.....	27
Psychoneurosis, unclassified.....	64	Spur, bone.....	2
Psychoneurotic personality.....	2	Strabismus.....	11
Psychosis, epileptic.....	5	Strain, muscular.....	10
Psychosis, intoxication, alcoholic.....	3	Stricture, urethra.....	6
Psychosis, manic depressive.....	31	Strongyloidiasis.....	1
Psychosis, with psychopathic personality.....	6	Stuttering.....	3
Psychosis, with other dis- abilities (mental deficiency).....	2	Syncope.....	11
Psychosis, with other dis- abilities (constitutional psy- chopathic inferiority).....	2	Synechia.....	2
Psychosis, with other dis- abilities (constitutional psy- chopathic state, inadequate personality).....	1	Synovitis, chronic.....	16
Psychosis, with other dis- abilities (parenchymatous goiter).....	1	Synovitis, traumatic.....	1
Psychosis, unclassified.....	18	Syphilis.....	42
Pterygium.....	3	Syphilis, congenital.....	1
Ptosis, congenital.....	2	Syphilis, seropositive only.....	3
Purpura hemorrhagica.....	1	Syringomyelia.....	1
Pyelitis, chronic.....	1	Tabes dorsalis.....	6
Pyelonephritis.....	1	Tachycardia.....	5
Pylorospasm.....	2	Talipes.....	5
		Tenosynovitis, chronic.....	3
		Thrombo-angiitis obliterans.....	5
		Thrombosis, coronary artery.....	3
		Thrombosis, deep veins, right lower extremity.....	1
		Thrombosis, dorsalis pedis artery.....	1
		Thrombosis, right femoral vein.....	1
		Tic.....	1
		Tracheobronchitis, chronic.....	1
		Trachoma.....	1
		Tremor, familial.....	1
		Tuberculosis, cervical gland.....	1
		Tuberculosis, lumbar vertebrae.....	1

Cause	Num- ber of medical surveys	Cause	Num- ber of medical surveys
Tuberculosis, cervical verte- brae	1	Undulant fever	2
Tuberculosis, general miliary	2	Union of fracture, faulty	41
Tuberculosis, peritoneum	1	Urethritis, chronic, nonvener- eal	1
Tuberculosis, pulmonary, acute pneumonic	1	Urticaria	5
Tuberculosis, pulmonary, chronic, advanced	94	Valvular heart disease, aortic and mitral	34
Tuberculosis, pulmonary, chronic, arrested	178	Valvular heart disease, aortic insufficiency	24
Tuberculosis, primary, healed	14	Valvular heart disease, aortic stenosis	4
Tuberculosis, pulmonary, un- stable, primary, complex	3	Valvular heart disease, mitral insufficiency	69
Tuberculosis, pulmonary, chronic inactive	2	Valvular heart disease, mitral stenosis	59
Tumor, mediastinum	2	Valvular heart disease, pul- monic	1
Tumor, mixed, activity un- known	4	Varicose veins	14
Tumor, activity unknown	1	Vertigo	2
Ulcer, duodenum	249	Visual aphasia	2
Ulcer, gastric	1	Wound, gunshot	1
Ulcer, leg	1		
Ulcer, stomach	14		
Ulcer, stomach, perforated	1	Total	6, 311

NOTES ON OUR RESERVE CONTRIBUTORS

Allen, Henry C., Lieutenant (MC) USNR (*A Year's Laboratory Experience of U. S. Naval Base Hospital* —; *with a Case Report of a Transfusion Phenomenon*, p. 1638). M. D., Washington University Medical School, 1933. Intern, St. Louis City Hospital 1933-34; resident, St. Louis City Sanitarium, 1934-36; assistant in pathology, Washington School of Medicine, 1937-38; instructor, 1938; associate, clinical pathology, Clinical Pathological Laboratory, St. Louis, Mo., 1936-; St. John's Hospital, St. Louis, 1936-; St. Louis County Hospital, 1937-; Christian Welfare Hospital, East St. Louis, Ill., 1936-; St. Elizabeth's Hospital, Granite City, Ill., 1936-40; instructor in pathology, College of Mortuary Science, St. Louis, Mo., 1937-. Member St. Louis Medical Society; Missouri Medical Association; American Medical Association; diplomate, American Board of Pathology, 1940.

Barnard, Hamilton I., Lieutenant Commander (MC) USNR (*Rubber-Surface Skin Traction for Retracting Amputation Stumps*, p. 1742). M. D., University of Colorado, 1921. United States Veterans' Bureau, 1922-24. Instructor, 1927-34, assistant professor of surgery, 1934-42, acting head, 1940-42, Orthopedic Department, University of Colorado; principal in orthopedics at Children's, Denver General, and St. Luke's hospitals, Denver, Colo., 1928-42. Fellow: American College of Surgeons; American Academy of Orthopedics, 1934; American Medical Association; International College of Surgeons, 1940. Diplomate, American Board of Orthopedics, 1939; member Denver County Medical Society (President, 1940).

Becker, Marvin C., Lieutenant (MC) USNR (*Activities of the Orthopedic Department at U. S. Naval Base Hospital* —, p. 1540). A. B., University of Michigan, 1936; M. D., New York University College of Medicine, 1940. Intern, psychiatry, New Jersey State Hospital, Trenton, N. J., June 1940-Jan. 1941; intern, rotating, Newark City Hospital, 1941.

Beymer, Charles B., Lieutenant Commander (MC) USNR (*Activities of the Orthopedic Department at U. S. Naval Base Hospital* —, p. 1540). B. S., University of Nebraska, 1923; M. D., 1925. Private practice 1925-; staff Twin Falls County Hospital, Twin Falls, Idaho. Member Idaho State Medical Association; South Side Medical Society of Idaho; American Medical Association; fellow American College of Surgeons.

Bird, Lee C., Lieutenant Commander (MC) USNR (*A Study of Psychiatric Casualties Received at U. S. Naval Base Hospital* —; *from the Solomon Islands Battle Area*, p. 1627). B. S., University of Wisconsin, 1931; M. D., 1933. Rotating internship, Mercy Hospital, Janesville, Wis., 1933-34; U. S. Public Health Service, U. S. Marine Hospital, Boston, 1934-35. Assistant psychiatrist: State Hospital, Mt. Pleasant, Iowa, 1935-36; Bangor State Hospital, Bangor, Maine, Jan.-July 1938; New Hampshire State Hospital, Concord, N. H.,

1939; resident psychiatrist: Boston Psychopathic Hospital, 1937-38; University State Hospital, Iowa City, Iowa, July 1938-July 1939. Member American Psychiatric Association; Merrimack County Medical Society; New Hampshire State Medical Society.

Birkbeck, Norman J., Lieutenant Commander (MC) USNR (*Experiences in the X-ray Department of U. S. Naval Base Hospital* ———, p. 1646). M. D., Wisconsin University, 1929. Intern, Columbia Hospital, Milwaukee, Wis., 1929-31; resident, radiology, University Hospital, Ann Arbor, Mich., 1931-34. Certified, radiology, 1937. Senior consultant, radiology, Miami Valley Hospital. Member American Medical Association; Ohio Medical Association; diplomate American Board of Radiology.

Blatchford, Frank W., Jr., Lieutenant (MC) USNR (*Primary Atypical Pneumonia; Experiences at U. S. Naval Base Hospital* ———; p. 1624). A. B., Harvard University, 1930; M. D., Rush Medical College, 1935. Intern, Presbyterian Hospital, Chicago, Jan. 1934-Apr. 1935; medical resident, Sept. 1935-Sept. 1937. Member staff, Presbyterian Hospital, Chicago; faculty member, University of Illinois Medical School, Sept. 1941-; associate staff, Cook County Hospital, 1938-40; private practice, 1937-. Member Chicago Medical Society.

Brines, Osborne A., Commander (MC) USNR (*Adenocarcinoma of the Testis; Report of Case*, p. 1690). B. S., University of Michigan, 1915; M. D., Detroit College of Medicine and Surgery (Wayne University), 1927. Pathologist, Receiving Hospital, Detroit, 1927-; attending pathologist, Eloise Hospital, Eloise, Mich.; pathologist, Alexander Blain Hospital, Detroit; associate professor of pathology, Wayne University. Member, American Medical Association; American College of Physicians; American Association of Pathology and Bacteriology; American Society of Clinical Pathologists; diplomate American Board of Pathology.

Brown, Robert B., Lieutenant Commander (MC) USNR (*The Treatment of Burns; a Study Based on Experience with 360 Cases Seen on Board a U. S. Hospital Ship*, p. 1654). B. S., Allegheny College, 1929; M. D., University of Pennsylvania, 1933. Instructor in surgery, University of Pennsylvania Medical School; fellow, Harrison Department of Research Surgery. Member, Philadelphia Physiological Society; Philadelphia County and Pennsylvania State Medical Societies.

Butler, Oliver W., Commander (MC) USNR (*Urology at a Base Hospital in the War Zone; Experiences during One Year at U. S. Naval Base Hospital* ———, p. 1572; *Malaria Control Program on a South Pacific Base*, p. 1608). M.D., University of California, 1912. Intern, Los Angeles General Hospital, 1912-14; private practice, general surgery, Los Angeles, 1914-20; assistant in urology, University of California, 1920-23; chief urologist, Children's Hospital; staff member: University of Southern California, Los Angeles General Hospital, Hospital of the Good Samaritan. Member American Medical Association; California Medical Association; Los Angeles County Medical Association; American Board of Urology; American Urological Association; Western Branch American Urological Association.

Butt, Hugh R., Lieutenant (MC) USNR (*The Treatment of Naval Personnel with Peptic Ulcer*, p. 1679). M. D., University of Virginia, 1933; M. S., University of Minnesota, 1937. Fellow in medicine, Mayo Foundation, Mayo Clinic, Aug. 1934-July 1937; first assistant, Division of Medicine, Mayo Clinic, July 1937-July 1938; instructor in medicine, Mayo Foundation, University of Minnesota, July 1938-; consulting physician, St. Mary's, Colonial, and associate hospitals, July 1938-. Member Olmsted, Houston, Fillmore, Dodge

County Medical Societies; Southern Minnesota Medical Association; Minnesota State Medical Association; American Medical Association; Central Society for Clinical Research; American College of Physicians.

Charles, John D., Lieutenant (MC) USNR (*Proctology in an Advance Base Hospital; Experiences at U. S. Naval Base Hospital* —, p. 1577). M. D., Marquette University, 1934. Private practice, medicine, 1935-37; proctology, 1938-; associate staff Columbia Hospital Association; staff Milwaukee County Hospital; attending staff Milwaukee Hospital. Member County, State, and American Medical Associations; American Proctological Society; Milwaukee Academy of Medicine.

Coburn, Alvin F., Lieutenant Commander (MC) USNR (*The Disposition of Patients Stigmatized with Rheumatic Disease*. III, p. 1695). Phillips Andover, 1917; Yale, 1921; Johns Hopkins Medical School, 1925. Medical resident, Columbia, Presbyterian Medical Center, 1927-30; Proudft fellow, Columbia University, Department of Medicine, 1930-34; assistant professor of medicine, Columbia University, 1934-42; visiting investigator, Rockefeller Institute, 1940-41; hospital attending, Presbyterian Hospital, Vanderbilt Clinic, Bellevue, Willard Parker, and St. Vincent's hospitals; consultant, Grasslands Hospital. Member Committee on Public Health Relations; New York Academy of Medicine; Harvey Society; American Heart Association; Society of Clinical Investigation; Society of American Physicians; American Association for Advancement of Science. Author, *The Factor of Infection in the Rheumatic State*, 1931.

Coburn, Donald F., Lieutenant (MC) USNR (*The Surgical Management of War Wounds at U. S. Naval Base Hospital* —, p. 1525). M. D., Washington University, 1930. Intern, Montreal General Hospital, Montreal, Canada, 1930-33; resident, neurological surgery, Boston City Hospital, Boston, Mass., 1933-34; fellow in neuropathology, Montreal Neurological Institute, Montreal, Canada, 1935-36; resident in neurosurgery, Boston City Hospital, 1936-37. Practice of neurological surgery, Kansas City, 1937-42; assistant in surgery, University of Kansas School of Medicine; staff member: Bethany Hospital, Children's Mercy Hospital; Menorah Hospital; Providence Hospital; Research Hospital; St. Joseph's Hospital; St. Luke's Hospital; St. Mary's Hospital; St. Margaret's Hospital; and Trinity Lutheran Hospital. Member American Medical Association; American Academy of Neurological Surgery; Missouri State Medical Society; diplomate American Board of Neurological Surgery.

Coleman, Marion W., Commander (MC) USNR (*Urology at a Base Hospital in the War Zone; Experiences During One Year at U. S. Naval Base Hospital* —, p. 1572). B. A., Ohio State University, 1921; M. D., Jefferson Medical College, Philadelphia, 1925. Resident, Protestant Episcopal Hospital of Philadelphia, 1925-27; private practice, Dayton, Ohio, 1927-41; senior urologist, Miami Valley Hospital and Good Samaritan Hospital, Dayton, Ohio. Fellow American College of Surgeons; member: American Urological Association; American Medical Association; Ohio State and County Medical Societies; Tri-State Medical Society.

Cronin, Donald J., Lieutenant (MC) USNR (*The Department of Otorhinolaryngology, U. S. Naval Base Hospital* —, p. 1565). B. S., University of Minnesota, 1935; M. D., 1939. Intern, Minneapolis General Hospital, 1939-41; resident, McCannel Eye, Ear, Nose, and Throat Clinic, Minot, N. Dak., 1941-42. Member Northwest District Medical Society, North Dakota.

- Culler, Arthur M.**, Commander (MC) USNR (*War Injuries of the Eye; a Study of 118 Cases Encountered at U. S. Naval Base Hospital* —, p. 1557). M. D., Michigan University, 1926. Intern, 1926-27, and resident in ophthalmology, 1927-28, University Hospital, Ann Arbor, Mich.; instructor and Weeks research fellow, ophthalmology, Michigan University, 1928-30. Certified, 1931. Ophthalmologist, Good Samaritan Hospital; senior ophthalmologist, Miami Valley Hospital. Member American Academy of Ophthalmology and Otolaryngology; American Medical Association; American Ophthalmological Society; Association for Research in Ophthalmology.
- Eads, John T.**, Lieutenant Commander (MC) USNR (*Favism; Report of a Case*, p. 1720). M. D., Jefferson Medical College, 1926. Assistant professor, medicine, Jefferson Medical College; assistant visiting physician, Jefferson Medical College Hospital, 1938—. Member American College of Physicians; Philadelphia College of Physicians; American Medical Association; Pennsylvania State and Philadelphia County Medical Societies.
- Essig, Jacob I.**, Lieutenant (DC) USNR (*Activities of the Dental Department of the U. S. Naval Base Hospital* —, p. 1649). D. D. S., School of Dentistry, University of Louisville, 1924. Instructor, School of Dentistry, University of Louisville, 1924-28; private dental practice, Louisville, 1925—. Member Kentucky State Dental Association; American Dental Association.
- Fellows, Armin T.**, Lieutenant Commander (DC) USNR (*Treatment of Vincent's Angina*, p. 1733). D. D. S., University of Pennsylvania, 1911. Private dental practice, Philadelphia, 1911-; dental consultant, Maryland Casualty Company (Philadelphia branch). Member American Dental Association; Pennsylvania State Dental Society; Philadelphia County Dental Society; Pennsylvania Association of Dental Surgeons.
- Ferguson, Lewis K.**, Commander (MC) USNR (*The Treatment of Burns; a Discussion Based on Experience with 360 Cases Seen on Board a U. S. Hospital Ship*, p. 1654). M. D., University of Pennsylvania Medical School, 1923. Fellow in surgery, University of Pennsylvania Hospital, 1923-25; year's study in Europe, 1928-29. Private practice, Philadelphia, 1925—. Assistant surgeon, University Hospital, Philadelphia; assistant professor, University of Pennsylvania; surgeon, Student Health Service, University of Pennsylvania; chief of the proctologic clinics, Hospital of the University of Pennsylvania and Philadelphia General Hospital; proctologist, Policemen and Firemen of Philadelphia; chief of the industrial clinic, Hospital of the University of Pennsylvania. Member, American Medical Association; American College of Surgeons; Philadelphia Academy of Surgery; American Gastroenterologic Society; Physiological Society, Philadelphia; American Society for Experimental Pathology. Author, *Surgery of the Ambulatory Patient*, 1942; coauthor, *Surgical Nursing*, 6th edition, 1940; surgical editor, *Digest of Treatment*.
- Fox, Theodore A.**, Lieutenant (MC) USNR (*Attenuated Tetanus; a Case Report*, p. 1724). B. S., University of Chicago, 1933; M. D., Rush Medical College, University of Chicago, 1937. Intern, fellow in pathology, and resident in fractures, Cook County Hospital, Chicago, Ill., 1937-40; resident in surgery, Mt. Sinai Hospital, New York, N. Y., 1940-41. Member Chicago Medical Society.
- Friedman, Nathan H.**, Lieutenant (MC) USNR (*Hazards of Tetrachlorethane on Shipboard; a Case Report of Acute Narcosis*, p. 1792). B. S., Tufts College, 1930; M. D., Tufts College Medical School, 1933. Student teaching fellowship in bacteriology and pathology, Tufts College Medical School, 1932-

33; rotating internship, Bridgeport General Hospital, Bridgeport, Conn., 1933-34; resident physician, Bridgeport City Dispensary, 1934-35; general practice, 1935-42.

Fronek, Otis J., Lieutenant Commander (MC) USNR (*Prevention of Aero-Otitis Media*, p. 1744). A. B., 1933, Miami University; M. D., 1936, New York Medical College. Intern, Huron Road Hospital, East Cleveland, O., 1936-1937; Resident in Surgery, Huron Road Hospital, 1937-1939; Surgical Staff, Huron Road Hospital; private practice, Cleveland Heights, O., 1939. Member Academy of Medicine, Cleveland, O.; Association of Military Surgeons.

Fry, Francis O., Lieutenant (MC) USNR (*Enteric Diseases Encountered at U. S. Naval Base Hospital* —, p. 1613). B. A., Bowling Green State University, 1935; M. D., Rush Medical College, University of Chicago, 1938. Intern and resident in medicine, St. Luke's Hospital, Cleveland, Ohio, 1938-42. Member Academy of Medicine, Cleveland, Ohio.

Gillespie, Clarence E., Lieutenant (MC) USNR (*The Surgical Management of War Wounds at U. S. Naval Base Hospital*, —, p. 1525). M. D., University of Tennessee College of Medicine, 1935. Intern, John Gaston Hospital, Memphis, Tenn., 1936-37; resident in pathology, John Gaston Hospital and University of Tennessee College of Medicine, July 1937-July 1939; resident surgeon, Steiner Clinic for Cancer and Allied Diseases, Atlanta, Ga., July 1939-40; assistant resident surgeon, John Gaston Hospital and University of Tennessee College of Medicine, July 1940-July 1941.

Gudex, Thomas V., Lieutenant Commander (MC) USNR (*Enteric Diseases Encountered at U. S. Naval Base Hospital* —, p. 1613; *Experiences with Malaria at an Advance Base in the South Pacific*, p. 1588). B. S., M. D., University of Louisville, 1928. Intern, Louisville General Hospital, 1928-29; instructor in medicine, University of Louisville, 1929-; private practice, Louisville, Ky., 1929-42; staff member Portland Health Center, Louisville, Ky., 1929-42, and Waverly Hills Tuberculosis Sanatorium Clinics, 1930-36. Member Jefferson County Medical Society; Kentucky State Medical Society, and American Medical Association.

Gurdin, Michael M., Lieutenant Commander (MC) USNR (*The Early Care of Nasal Fractures*, p. 1706). M. D. Tulane University of Louisiana, 1933. Intern, Cedars of Lebanon Hospital, Hollywood, 1933-34; ward surgeon, Army and Navy General Hospital, Hot Springs National Park, Ark., 1935; resident surgeon, Cedars of Lebanon, Hollywood, 1935-36; attending plastic surgeon, Cedars of Lebanon, Hollywood; private practice, reconstructive-plastic surgery. Member American Medical, California, Los Angeles County, and Honolulu County Medical Associations; National Board of Medical Examiners, 1936.

Hamrick, Wendell H., Lieutenant (MC) USNR (*A Technic for Introducing the Miller-Abbott Tube*, p. 1737). B. A., Rice Institute, 1929; M. D., University of Texas, 1934; candidate for M. M. Sc., University of Pennsylvania (upon completion of thesis). Intern, Jefferson Davis Hospital, Houston, Tex., 1934-35; house physician, Memorial Hospital, Houston, 1935-36; private practice, Mt. Belvieu, Tex., 1936-37; project surgeon, Marshall Ford Dam, Tex., 1937-39. Graduate studies in surgery, University of Pennsylvania Graduate School of Medicine, 1939-40; resident in surgery, Southern Pacific Hospital, Houston, Tex., 1940-42; private practice, surgery, Houston, Tex., 1942. Member American Medical Association; State Medical Association of Texas.

Hankins, Franklyn D., Lieutenant Commander (MC) USNR (*Lead Poisoning as a Clinical Entity During the Reconditioning of Warships*, p. 1785). M. D.,

College of Medical Evangelists, 1932. Intern-resident, tumor surgery, Los Angeles County Hospital, 1931-34; assistant, radiology, California Institute of Technology, 1934-35; attending surgeon and chairman of tumor clinic, Riverside County Hospital, 1935. Member American Medical Association; American Radium Society; American College of Radiology; Pacific Roentgen Society.

Hartman, Jerome, Commander (MC) USNR (*Activities of the Orthopedic Department at U. S. Naval Base Hospital* —, p. 1540). M. D., Jefferson Medical College, 1923. Certified, 1936. Senior Orthopedist: Good Samaritan Hospital; Miami Valley Hospital. Member American Medical Association; American Academy of Orthopaedic Surgeons.

Hartwig, Elmer, Lieutenant Commander (DC) USNR (*Activities of the Dental Department of U. S. Naval Base Hospital* —, p. 1649). D. D. S., Dental School, St. Louis University, 1929. Private practice for 11 years. Member St. Louis Dental Society; Missouri State Dental Society; American Dental Association; St. Louis Society of Dental Science; North St. Louis Association.

Huston, Harry R., Commander (MC) USNR (*The Surgical Management of War Wounds at U. S. Naval Base Hospital* —, p. 1525; *War Wounds of the Chest; A Report of 278 Cases Encountered at U. S. Naval Base Hospital* —, p. 1579). M. D. Medical College of Virginia, 1920. Intern, Miami Valley Hospital, Dayton, Ohio, 1920-21. Private practice, 1921-40; senior surgeon, Miami Valley Hospital; attending surgeon, National Military Home, Dayton, Ohio. Fellow American College of Surgeons; member American Medical Association; Tri-State Medical Society; Ohio State Medical Association; American Society of Gynecology, Obstetrics, and General Abdominal Surgery.

Kern, Richard A., Captain (MC) USNR (*The Treatment of Burns; a Discussion Based on Experience with 360 Cases Seen on Board a U. S. Hospital Ship*, p. 1654). A. B., University of Pennsylvania, 1910; M. D., 1914. Instructor, medicine, University of Pennsylvania, 1916-21; associate, University of Pennsylvania School of Medicine and Graduate School of Medicine, 1921-28; assistant professor, 1928-34; professor, clinical medicine, 1934-; assistant physician, University Hospital. American Medical Association; associate American Physicians; American Society for Clinical Investigation; Society for the Study of Asthma (president, 1934); American Clinical and Climatological Association; American College of Physicians; American Association for the Study of Allergy (president, 1931); College of Physicians of Philadelphia; Pathological Society of Philadelphia.

Kessler, Henry H., Commander (MC) USNR (*Activities of the Orthopedic Department of U. S. Naval Base Hospital* —, p. 1540). M. D., Cornell University Medical School, 1919. Intern, New York City Hospital. Certified, 1937. Attending orthopedic surgeon: Hasbrouck Heights Hospital, Hasbrouck Heights; Hospital and Home for Crippled Children; Newark Beth Israel Hospital; Newark City Hospital. Medical director, New Jersey State Rehabilitation Clinic. Fellow American College of Surgeons. Member American Academy of Orthopaedic Surgeons; American Medical Association. (Member Council Industrial Health; Hunterian Lect., London, 1935.) Author: *Accidental Injuries*, Philadelphia, Pa., 1931, second edition 1941; *Rehabilitation of the Crippled and Disabled*, Columbia University Press, 1934. Delegate International Congress for Accidents, Geneva, 1931; Brussels, 1935; Frankfort, 1938. Special Advisor, Parliamentary Commission on Rehabilitation, London, 1938-39. Winner, Gold Medal, American Academy of Orthopedic Surgeons, 1936.

Knox, Stuart C., Lieutenant (MC) USNR (*An Improvised Field Method of Management of Fungus Infections of the Feet*, p. 1746). M. D., College of Medical Evangelists, 1934. Intern, Hollywood-Presbyterian Hospital, 1933-34; assistant to Dr. Rufus David of Los Angeles, 1934-37; member attending staff, Hollywood-Presbyterian Hospital; Private practice, medicine and surgery, 1937-. Member Los Angeles County Medical Association; California Medical Association; American Medical Association.

Leake, William H., Commander (MC) USNR (*Primary Atypical Pneumonia; Experiences at U. S. Naval Base Hospital* —, p. 1624; *Experiences with Malaria at an Advance Base in the South Pacific*, p. 1588). M. D., Vanderbilt University, 1916. Intern, Presbyterian Hospital, New York, N. Y.; resident in medicine, Vanderbilt University Hospital, 1920-22; associate clinical professor of medicine, University of Southern California, 1931-; consultant in cardiology, United States Veterans' Facility, West Los Angeles; examiner, Police and Fire Pension Board, Los Angeles; attending physician, senior staff, Los Angeles County Hospital; attending physician: Hollywood-Presbyterian Hospital; Hospital of the Good Samaritan, Los Angeles; private practice, Los Angeles, 1922-. Member American Medical Association; American College of Physicians; Association of Military Surgeons; American Heart Association; California Heart Association; Pacific Interurban Clinical Club; Los Angeles Academy of Medicine. Certified, American Board of Internal Medicine.

Lind, Samuel C., Commander (MC) USNR (*Training of the Medical Divisions of Units Assigned to Duty Overseas*, p. 1702). A. B., 1908, M. D., 1911, Western Reserve University. Intern, Cleveland City Hospital. Postgraduate study, University of Bern, 1921-22; clinical visits: Germany, 1932; Switzerland, 1934; Germany, 1935; England, 1937; visiting surgeon: Deaconess Evangelical Hospital, Lakewood City Hospital, and Lutheran Hospital, Cleveland, Ohio. Fellow American College of Surgeons; member Cleveland Academy of Medicine (President, 1930-31); American Medical Association.

Lund, Le Val, Lieutenant Commander (MC) USNR (*The Department of Otorhinolaryngology, U. S. Naval Base Hospital* —, p. 1565). M. D., University of Southern California, 1916. United States Navy 1917-1919. Intern, Los Angeles General Hospital, 1916-1917; Brooklyn Eye and Ear Hospital, 1919-1921; New York Post-graduate, 1919. Attending staff Los Angeles General Hospital, 1921-1930. Private practice Los Angeles 1921-1941. Member American Medical Association; California State Medical Association; Los Angeles Society of Otolaryngology and Ophthalmology; Hollywood Academy of Medicine; diplomate American Board of Ophthalmology.

Macnish, James M., Lieutenant Commander (MC) USNR (*Urology at a Base Hospital in the War Zone; Experiences During One Year at U. S. Naval Base Hospital* —, p. 1572). M. D., Washington University (St. Louis), 1929. Junior, senior, and resident, medicine, 1929-34, surg., gynec., resident, urology, 1932-34, St. Louis City Hospital No. 1. Certified, 1938. Visiting urologist: City Infirmary; City Isolation Hospital; City Sanitarium; Evangelical Deaconess Home & Hospital; Firmin Desloge Hospital; Josephine Heitkamp Memorial Hospital; Missouri Baptist Hospital; St. Louis City Hospital. Instructor, urology, St. Louis University. Member American Medical Association; American Urological Association; American Urological Association (South Central Section).

Marshall, Thomas M., Lieutenant, junior grade (MC) USNR (*Meningococci Meningitis*, p. 1726). B. A., University of Kentucky, 1938; M. D., University of Louisville, Kentucky, 1941. Rotating Internship, Louisville General Hospital, 1941-42.

McCarthy, Charles L., Commander (MC) USNR (*Subcutaneous Juxta-Articular Nodules; a Study of Their Clinical and Histologic Characteristics*, p. 1683). B. S., Princeton University, 1912; M. D., Johns Hopkins, 1916. Intern, Johns Hopkins Hospital, 1917. U. S. Naval Medical Corps, 1917-21. Postgraduate studies in dermatology and mycology: 2 years, University Berlin, Germany; 2 years, Sorbonne University, Paris. Private practice, Washington, D. C., 1925-42; formerly clinical professor, dermatology, Georgetown Medical School. Member American Dermatological Association; American Medical Association; corresponding member of French Dermatological Society; formerly president International Medical Club. Society for Investigative Dermatology. Diplomat, American Board of Dermatology. Author: *Histopathology of Skin Diseases*; *Diagnosis and Treatment of Diseases of the Hair*, C. V. Mosby Co., 1940.

McCullough, Clifford P., Commander (MC) USNR (*A Device for Reduction of Contact Exposure in Sickbays Afloat*, p. 1750). B. S., University of Chicago, 1911; M. D., Rush Medical College, 1914. Intern, Presbyterian Hospital Chicago, 1914-16; associate in pathology, Dr. Ludwig Hektoen, 1913-14, and instructor, Rush Medical College, 1916-21; staff member Alice Home Hospital, Lake Forest, 1919-; general practice 1917-. Member Lake County Medical Society (President 1935 and 1936); American Medical Association; Chicago Society of Internal Medicine.

McMahon, Alphonse, Commander (MC) USNR (*War Wounds of the Chest; a Report of 278 Cases Encountered at U. S. Naval Base Hospital ———*, p. 1579; *Experiences with Malaria at an Advance Base in the South Pacific*, p. 1588). M. D., St. Louis University, 1919; M. A. in Psychology, St. Louis University, 1936. Intern, St. Luke's Hospital, 1919; St. Vincent's Hospital, Los Angeles, Calif., 1920; assistant resident physician, Pottenger Sanatorium and Clinic, Monrovia, Calif., 1920-21. Certified 1937. Associate physician: St. John's Hospital; St. Mary's Group Hospitals (St. Louis University); assistant physician: De Paul Hospital; St. Luke's Hospital; Cons. Int.: Frisco Employes' Hospital; Mt. St. Rose Sanatorium; Robert Koch Hospital; St. Vincent's Sanitarium. Senior instructor, St. Louis University. Member American Heart Association; American Medical Association (Vice-President, 1939-40); American Therapeutic Society (President 1937-38; Vice Chairman Council, 1939-40); Association for the Study of Internal Secretions; International Society of Gastro-Enterology; National Gastro-Enterological Association; National Tuberculosis Association; Southern Medical Association; fellow American College of Physicians.

Montgomery, Hugh, Lieutenant (MC) USNR (*The Treatment of Burns; a Discussion Based on Experience with 360 Cases Seen on Board a U. S. Hospital Ship*, p. 1654). M. D., Harvard Medical School, 1930. Intern: Massachusetts General Hospital, Boston, 1931-32; Pennsylvania University Hospital, 1935-36. Research fellow, pharm., 1932-35; Henrietta Heckscher fellow, medicine, 1937-38; Justice M. Thompson fellow, gastro-enterology, 1938-39, Pennsylvania University. Certificate 1940. Assistant ward physician, charge peripheral vascular clinic and mid-chief peripheral vascular clinic, Pennsylvania University Hospital. Associate, medicine, Pennsylvania University. Member American Heart Association; American Medical Association; American Society for Clinical Investigation.

Norris, Robert F., Lieutenant Commander (MC) USNR (*The Treatment of Burns; a Discussion Based on Experience with 360 Cases Seen on Board a U. S. Hospital Ship*, p. 1654). A. B., Princeton University, 1928; M. D., University of Pennsylvania, 1932. Intern, Pennsylvania Hospital, Philadelphia, 1932-34; assistant in pathology, Johns Hopkins University, 1934-35; assistant director, Ayer Clinical Laboratory, Pennsylvania Hospital, Philadelphia, 1935-41; assistant instructor in pathology and medicine, University of Pennsylvania, 1936-41. Fellow American Medical Association; member American Association of Pathologists and Bacteriologists; American Association for the Advancement of Sciences; fellow College of Physicians of Philadelphia.

Owen, Eugene P., Commander (MC) USNR (*The Surgical Management of War Wounds at U. S. Naval Base Hospital* —, p. 1525). A. B., University of California, 1926; M. D., Harvard Medical School, 1929. Intern and resident in surgery, Good Samaritan Hospital, Portland, Ore.; clinical instructor, surgery, University of Oregon Medical School; instructor in anatomy, North Pacific College of Dentistry. Member American Medical Association; Oregon State Medical Society.

Patterson, Lawrence F., Commander (DC) USNR (*Activities of the Dental Department of U. S. Naval Base Hospital* —, p. 1649). D. D. S., Ohio College of Dental Surgery, 1925. Member staff, Miami Valley Hospital, Dayton, Ohio. Member American Dental Association; Ohio State Dental Society; Dayton Dental Society.

Phillips, Kenneth, Lieutenant Commander (MC) USNR (*The Treatment of Gonorrheal Ophthalmia by Diathermy in Conjunction with Sulfonamides*, p. 1727). M. D., Rush Medical College, 1925. Intern, Wesley Memorial Hospital, Chicago, Ill., 1925-27; medical resident, James M. Jackson Memorial Hospital, 1 year. Certified 1938. Chief, medical service, James M. Jackson Memorial Hospital; medical director, Miami Physical Therapeutic Centre. Fellow American College of Physicians. Member American Congress of Physical Therapy; American Medical Association; American Therapeutic Society; Southern Medical Association.

Phinney, Charles R., Lieutenant, junior grade (DC) USNR (*The Restoration of Incisal Corners with Amalgam*, p. 1752). D. D. S., School of Dental and Oral Surgery, Columbia University, 1934. Private dental practice, 1934-42. Member American Dental Association; New York State Dental Society; New York Academy of Dentistry.

Powers, William L., Lieutenant Commander (MC) USNR (*Acute Infective Jaundice at U. S. Naval Base Hospital* —, p. 1620). B. A., M. D., Baylor University College of Medicine, 1931. Intern, French Hospital, New York City, 1931-32; resident in internal medicine, Kings County Hospital, Brooklyn, New York. Attending physician, Wichita General Hospital and Bethania Hospital, Wichita Falls, Tex. Private practice, internal medicine, Wichita Falls, Tex., 1933-40. Member Texas Club of Internists; associate American College of Physicians.

Ridgeway, Elmer, Jr., Lieutenant (MC) USNR (*The Surgical Management of War Wounds at U. S. Naval Base Hospital* —, p. 1525). B. S. in medicine, Oklahoma University, 1938; M. D., University of Oklahoma School of Medicine, 1940. Intern, Touro Infirmary, New Orleans, 1941-42. Member Oklahoma State Medical Association; Orleans Parish Medical Society.

Rueckert, Ray R., Lieutenant (MC) USNR (*Experiences with Malaria at an Advanced Base in the South Pacific*, p. 1588). B. A., 1935, M. D., 1939, University of Wisconsin. Intern, Research Hospital, Kansas City, Missouri, 1939; staff member, Department of Student Health, University of Wisconsin, State of Wisconsin General Hospital, 1940-42. Member County and State Medical Societies.

Sagebiel, James L., Lieutenant Commander (MC) USNR (*A study of Psychiatric Casualties Received at U. S. Naval Base Hospital ———; from the Solomon Islands Area*, p. 1627; *Cerebral Malaria: a Report of 12 Cases Encountered at U. S. Naval Base Hospital ———*, p. 1596). M. D., Harvard Medical School, 1927. Intern: Peter Bent Brigham Hospital, Boston, 1927-29; Boston Lying-in Hospital, Boston, 1929. Postgraduate work, neurology and psychiatry, Post Grad. Columbia University, 1935-36. Certified, 1940 (neurology). Consultant neuro-psychiat., Kettering Institute of Medical Research; junior neuro-surg. and senior consultant neuro-psychiat.: Good Samaritan Hospital; Miami Valley Hospital; senior consultant, neuro-psychiat., St Elizabeths Hospital.

Schmoele, John M., Captain (MC) USNR (*The Surgical Management of War Wounds at U. S. Naval Base Hospital ———*, p. 1525). M. D., Pennsylvania University, 1919. Intern: Pennsylvania University Hospital, Philadelphia, 1919-20; Lankenau Hospital, Philadelphia, 1920-22; Children's Hospital, Los Angeles, 1922-23. Certified 1937. Fellow American College of Surgeons; member American Medical Association; Pacific Coast Surgical Association.

Shaw, Manley B., Lieutenant (MC) USNR (*Activities of the Orthopedic Department at U. S. Naval Base Hospital ———*, p. 1540). M. D., Johns Hopkins, 1931. Intern, surgery, 1931-32; intern, orthopedics, 1932-33; assistant resident, orthopedics, 1933-34; resident, orthopedics, 1934-35, Johns Hopkins Hospital, Baltimore, Md. Certified 1938. Orthopedic consultant, Idaho Crippled Children's Bureau. Member of staff: St. Alphonsus Hospital, St. Luke's Hospital, Boise, Idaho. Fellow American College of Surgeons; member American Medical Association; North Pacific Orthopaedic Society.

Shelburne, Samuel A., Lieutenant Commander (MC) USNR (*Thrombosis of the Axillary Vein; Report of 2 Cases with Clinical Investigations*, p. 1730). B. A. Rice Institute, Houston, Texas, 1922; M. D., University of Pennsylvania, 1927. Intern, University of Pennsylvania Hospital, 1927-29; assistant resident medicine, Peter Bent Brigham Hospital, Boston, Mass., 1929-30; teaching fellow in medicine, Lakeside Hospital and Western Reserve University, Cleveland, Ohio; assistant professor, medicine, and chief of cardiac clinics, Baylor University School of Medicine, Dallas, Tex. Member American Medical Association; Central Society for Clinical Research; licentiate, American Board of Internal Medicine; fellow American College of Physicians; Society for Experimental Biology and Medicine.

Shelton, Joseph M., Lieutenant (MC) USNR (*A Simplified Routine for the Treatment of Acne Vulgaris*, p. 1735). B. S., 1930, and M. D., 1933, University of Pittsburgh. Assistant, Anatomy Department, University of Pittsburgh, 1929-31; intern, Mercy Hospital, Pittsburgh, 1933-34; resident in pathology, Mercy Hospital, 1934-35; resident in dermatology and syphilology, Pittsburgh Skin and Cancer Foundation, 1935-38; senior staff member in dermatology, Washington (Pa.) Hospital, 1938-; dermatological staff, Pittsburgh Skin and Cancer Foundation, 1938-. Member American Medical Association, American Academy of Dermatology; Central States Dermatological Society; Society for Investigative Dermatology; Pittsburgh Dermatological Society. Certified by American Board of Dermatology and Syphilology, 1940.

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RELATION OF CRUSH SYNDROME TO BURNS AND WOUNDS

There is much evidence which seems to support the theory that toxemia is an important lethal factor in burns, and Drinker and his associates have recently found experimentally that lymph collected from a burned area exerts a toxic effect when reinjected into the blood stream of either burned or normal patients.—Lee, W. E.: The relation of the crush syndrome to that of burns and other types of traumatic wounds of human tissues. *Ann. Int. Med.* 18: 991-996 June 1943.

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